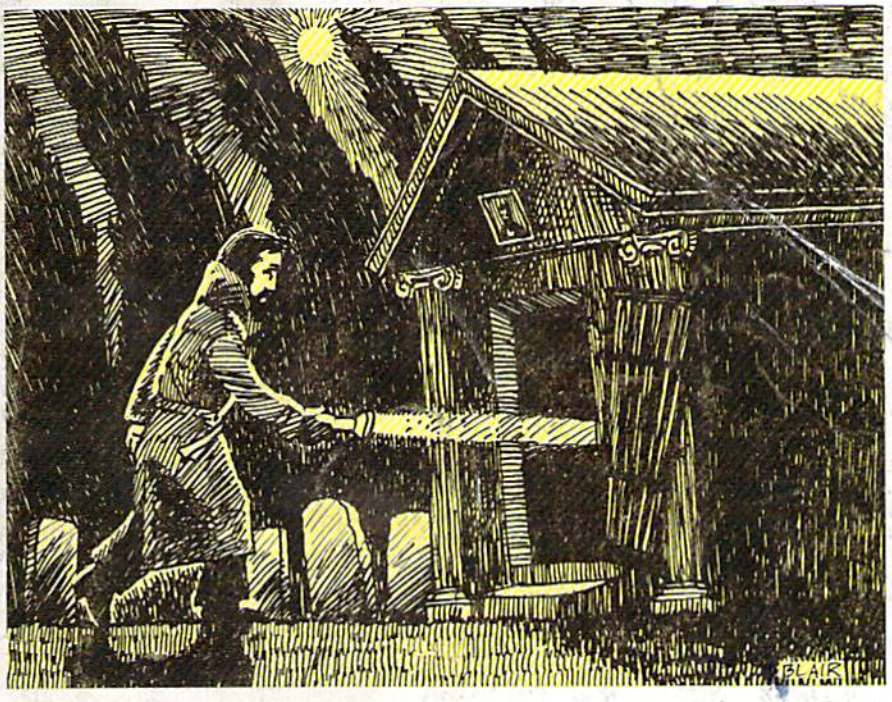
Commodore 64 Music For Non-Musicians

COMPUTE!'s GAZETTE

$2.95
February 1985
Issue 20, Vol. 3, No. 2
02220 $3.50 Canada

For Commodore VIC-20™ & 64™ Personal Computer Users



The Forbidden Crypt

The treasure is for the taking, but aggressive bats, snakes, spiders, and ghouls do all they can to prevent you. A multi-level action game for the VIC, 64, Plus/4, and 16.

Horizons

An in-depth look at the new Okimate-10 color printer.

Also In This Issue:

Machine Language For Beginners: Self-Modifying Programs

Inside View: Ryo Kawasaki

User Group Update

And More

Address File

Get organized with this easy-to-use filing system which offers many extra features, such as an alphabetical sort, instant search, and simple menu operation. For the VIC and 64.

Name That Note

Let your computer help your children learn the scales. A valuable educational program for the VIC, 64, Plus/4, and 16.

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RITEMAN R64.

IT MAKES THE RIGHT IMPRESSION!

Super impressive performance. Super impressive reliability. The Riteman R64 is the portable dot matrix impact printer for people who want to make the right impression!

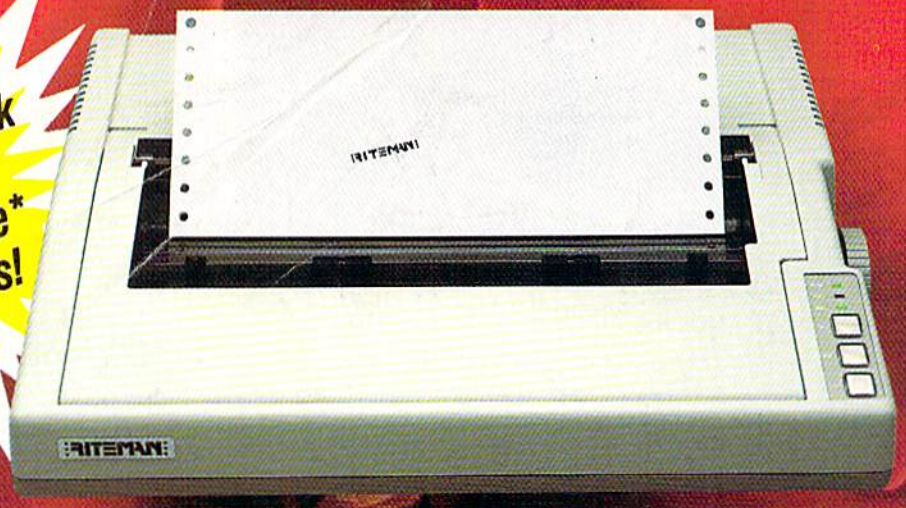
Plug and software compatible with the Commodore 64* — it's ready to run without any set-up hassles.

It even has a second parallel port and comes with Epson** software so it can be used with many other personal computer systems.

And the R64 prints at a healthy 120 cps with true descenders. . . on cut paper or continuous computer paper.

Compact, hard-working, and backed by a full one-year warranty. The Riteman R64. Call toll free for the dealer or department store nearest you: Toll Free number (800) 824-3044 (outside Calif.), (800) 421-2551 (in Calif.).

Ready to work with your Commodore* computers!



RITEMAN R64

Check out these impressive specs

• PRINT METHOD	Impact Dot Matrix	
• SOFTWARE COMPATIBILITY	(1) Commodore MPS-801, 803, VIC 1525 (see printing mode 1)	
	(2) RITEMAN PLUS, EPSON MX-80 Type 3 G+ (see printing mode 2)	
• PRINTING MODE	(1) Reversed, Expanded and combination	
	(2) Normal, Expanded, Compressed, Italics, Double Strike, Emphasized, Underline, Super/Subscripts and combination	
• CHARACTER MATRIX	9 x 9	
• CHARACTER TYPES	ASCII	96
	Italics	96
	Semi-graphics	32
	Commodore Graphic	64
• PRINT SPEED	120 CPS	
• LINEFEED SPEED	100 ms	
• THROUGH PUT SPEED	63 LPM	
• COPY	Original + 2	

• NUMBER OF COLUMNS	Normal	80
	Compressed	132
	Expanded	40
	Compressed Expanded	66
• LINE SPACING	1/6", 1/8", 7/72", N/72", N/216"	
• PAPER FEED	Friction Feed	
	Sprocket Feed	
• PAPER WIDTH	Cut Paper	4 - 9"
	Roll Paper	4 - 9"
	Fanfold Paper	9½"
		4 - 10" (option)
• RIBBON LIFE	1 million characters	
• INKED RIBBON	Exclusive Cassette Ribbon (Black)	
• HEAD LIFE	100 million characters	
• INTERFACE	Serial (Commodore)	
	Parallel (Centronics)	
• SIZE	2 7/8" (H) x 10 9/16" (D) x 14" (W)	
• WEIGHT	11 lbs.	
• WARRANTY	1 year (Parts and Labor)	
• ACCESSORY	Printer Cable (Commodore)	
• OPTION	Tractor Unit	

:RITEMAN:

INFORUNNER CORPORATION
Airport Business Center 431 N. Oak St. Inglewood, CA 90302

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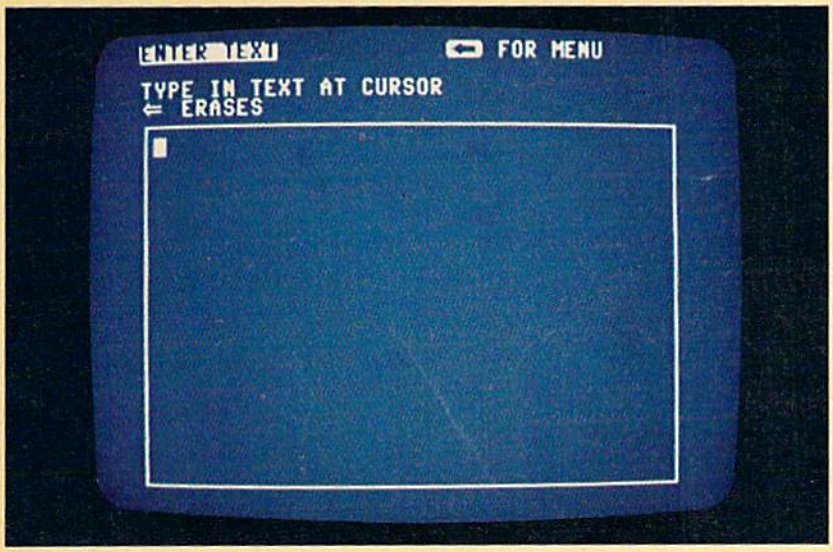
THE BANK STREET APPROACH TO WORD PROCESSING:

"SIMPLIFY! SIMPLIFY! SIMPLIFY!"



Using the Bank Street Writer is almost as simple as sitting down with a blank sheet of paper—just load the program and start writing.

In the weeks following its introduction, the Bank Street Writer became a leading best seller, and for some very simple reasons.

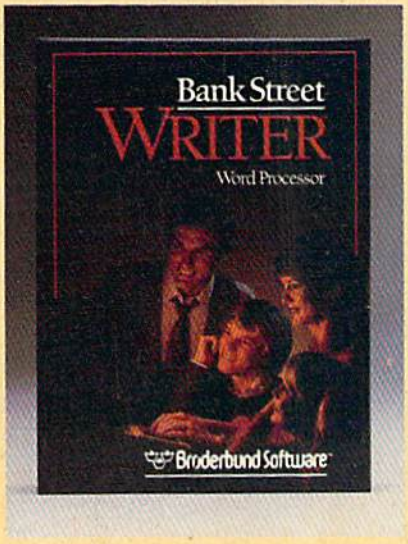
Here, finally, is a word processor that lives up to its promise to be easy to use. Most people (children included) can begin using it in a matter of minutes. Yet it puts you in full control of the powerful features most wanted in a sophisticated word processing program. All at a price that makes it as easy to buy as it is to use.

SIMPLY MORE SIMPLE.

The Bank Street Writer was developed in association with the Bank Street College of Education in New York. Designed to be its own tutor, the Writer will guide you along with on-screen prompts and easy-to-follow menus so you can concentrate on *what* you're doing instead of *how*. On-screen prompts and selections are in plain English, so there's no memorizing complex computer codes, keys or symbols. You'll be writing, correcting and rearranging your words with just a few keystrokes.

SIMPLY MORE POWERFUL.

For all its simplicity, the Bank Street Writer offers some very impressive features. You can center titles or indent with ease, and automatic word wrap lets you forget about pressing "return" at the end of each line. Never worry about changing your mind—you can add, move, insert or delete single words, lines or even entire blocks of text and then restore the deleted copy if you want it back. Using the search and replace option, the Bank Street Writer will scan your document for a particular word, replace it with another, and then verify the replacement. And when you're ready to print, you can format your text in any way you'd like. Answer a few simple questions and you can set margins and line spacing. The Writer will number pages either at the top or bottom or not at all—whichever you prefer. You can easily save your text on a disk, then retrieve it later to re-read, print or do more editing.



And to make your writing letter perfect, soon there will be a spelling checker available for use with the Bank Street Writer. Bank Street Speller finds errors instantly and corrects them by looking up entries in its electronic dictionary.

SIMPLY MORE AFFORDABLE.

Best of all, Bank Street Writer's suggested retail price of ***$49.95 for the Commodore 64*** makes it simply the best word processing value around. And it comes with everything you need, including complete documentation and a free back-up disk, to begin simplifying your life today.

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**SIMPLICITY. POWER. VALUE.
IT MAKES GOOD SENSE.
THE BANK STREET WRITER
FROM BRØDERBUND.**

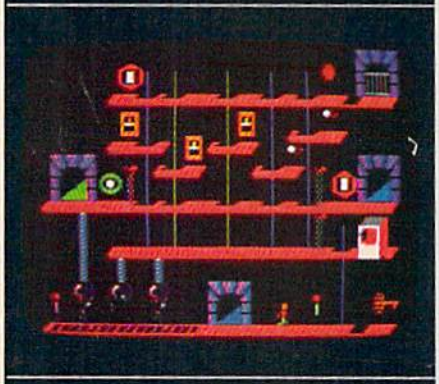
Brøderbund™

RAID ON BUNGELING BAY™

When you shopped for a computer, you wanted one with a lot of intelligence. This game may lead you to regret that choice, as your friendly little computer becomes the brains behind the most fantastic enemy you will ever face: The War Machine.

A monstrous artificial intelligence directs an endless army of self-replicating robot weapons and a complex of factories hidden on six heavily defended islands. Even as you strike at one island, robots beyond your field of vision continue to multiply...to repair the damage you've done...to attack and destroy.

Before all of Humankind is crushed beneath the Bungeling Empire's iron heel, one faint hope remains: you in your helicraft.

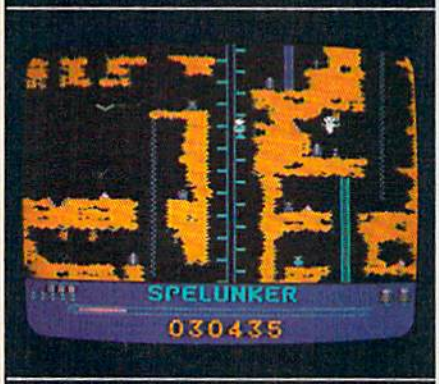


THE CASTLES OF DOCTOR CREEP™

Ever dream that you were locked in a haunted castle, wandering blindly through darkened corridors, never knowing what ghastly demons await you? Then you'll feel right at home in *The Castles of Doctor Creep.*

It's a maddening maze of 13 separate castles, more than 200 rooms in all. Sinister surprises await you behind every door: mummies and monsters, forcefields and death rays, trap doors and dead—*very* dead—ends. Remember where you've been and watch where you're going...there's got to be a way out *somewhere*!

Better hurry, or you'll wind up playing a rather unpleasant role in one of Doctor Creep's experiments.

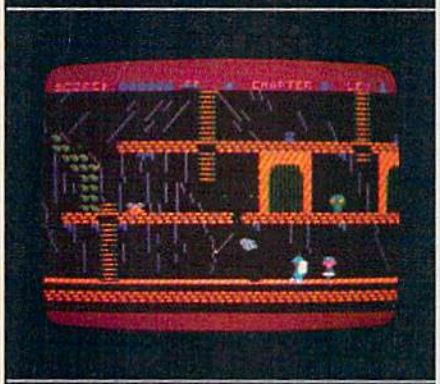


SPELUNKER™

Who knows what fabulous treasures—and unspeakable dangers—await you in the world's deepest cave? This is one game you can really get into... and into...and into.

Wander through miles of uncharted passageways, swinging on ropes and ladders, tumbling over subterranean falls and plunging to the very depths of the earth on an abandoned mine railroad. Deadly steam vents and boiling lava pits threaten you at every turn. Chattering bats and the Spirits of dead Spelunkers beg you to join them, permanently.

Let's face it: you're in deep, deep trouble.



WHISTLER'S BROTHER™

You're the star of a full-fledged arcade adventure—and the big question is whether it'll turn out to be a comedy or a tragedy. That's because your co-star and beloved brother, Archaeologist Fenton Q. Fogbank, is rather absent-minded and extremely accident-prone.

As you search for priceless treasures in steaming tropical jungles, ancient cliff villages, musty old tombs and glittering crystal caverns, you control both your character and your brother. The only way to keep him on track and out of trouble is to whistle and pray that he follows you to safety.

Poison arrows, runaway boulders, fearsome frogs and mysterious mummies are only a few of the hazards that'll make you wish you weren't your brother's keeper.

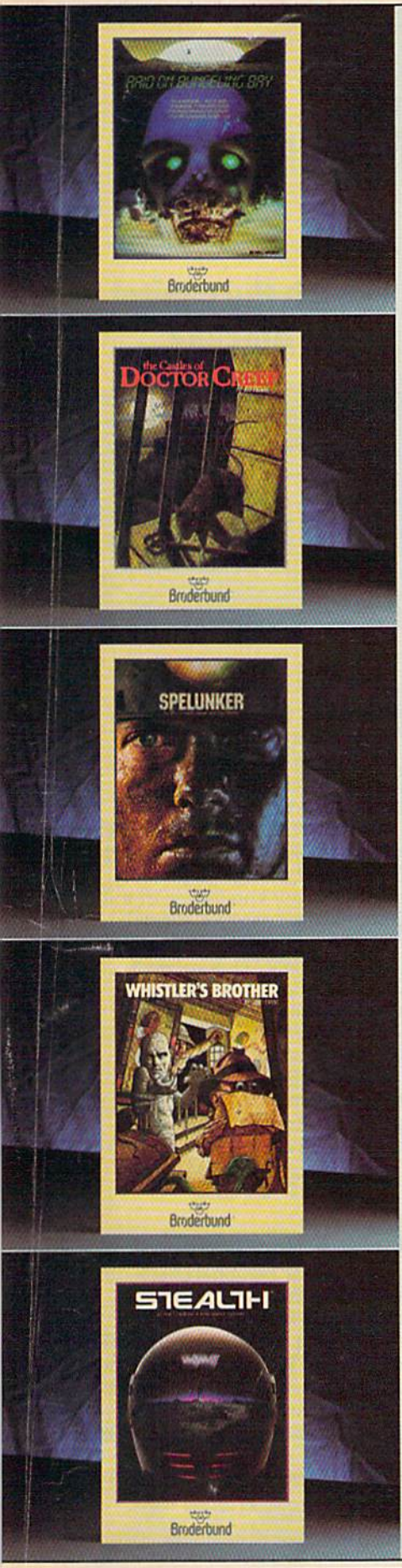
STEALTH™

You're all alone on a strange and forbidding planet. On the distant horizon, looming thousands of meters above the blasted landscape, lies your destination: The Dark Tower, home of the mysterious Council of Nine, cruel overlords of a conquered world.

You must maneuver your Stealth Starfighter through an unending assault by the Council's automated arsenal—jets and heat-seeking missiles, photon tanks and anti-aircraft batteries, vaporizing volcanoes and deadly energy fields. Outgunned and outmanned, you must press ever onward, with only your stealth to rely on.

You must reach the Tower. You must destroy it. There's no turning back.

All titles available on Commodore 64. Championship Lode Runner *also available on Apple II+, IIe, IIc.* Whistler's Brother, Spelunker *and* Stealth *also available for Atari Home Computers. Commodore 64 is a trademark of Commodore Electronics, Ltd. Apple is a trademark of Apple Computer, Inc. Atari is a trademark of Atari Corporation.*



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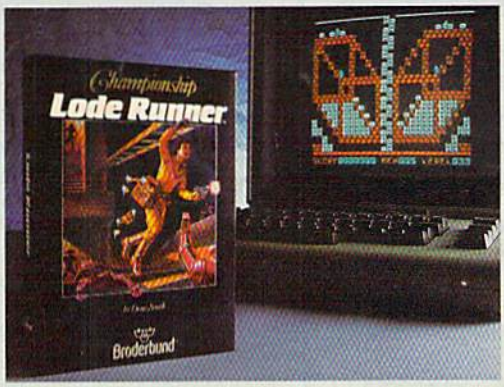
FOR COMMODORE.™



CHAMPIONSHIP LODE RUNNER™

It has come to our attention that some of you out there think you're pretty good at *Lode Runner,* 1983's best computer game. For those foolhardy few, we offer a challenge of a higher order: *Championship Lode Runner.*

With fifty fiendish Treasury Chambers: more intricate, more elaborate, more insidious than anything you've seen before. You'll need lots of skill, lots of smarts, and every ounce of your lode-running experience to have any hope at all of survival.

And if you haven't yet paid your dues on the original *Lode Runner,* don't even think of attempting this championship round.

Broderbund™

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Quick.

How many plates can the Juggler juggle?

Chinese Juggler

That depends on you. You are the Juggler and your act is the delicate art of plate spinning. Yours will be a tough act to follow if you succeed in matching colors and spinning plates on all 8 poles at the same time.

As your skill increases, so does the pace and the challenge of the game. You must act with speed and precision or the curtain will come down and your act will be all washed up!

Chinese Juggler is a refreshing departure from the usual shoot-em-ups and strategy games. It's fun, fast-paced and will delight players of any age. For Commodore 64. New from Creative Software.

$24.95

How do you moonwalk, snake and tut?

Break Street

You'll soon become a break dancing expert with our latest bestseller, Break Street. Now that combination of gymnastics, mime, funk, and just plain show-off, leaves the sidewalks and comes home to your Commodore 64.

Individual play guides you through the footwork of moonwalk, backspin, windmill, tut, and the rest of those sidewalk moves. Slow motion and lively musical accompaniment help you perform each move step by step. String together a whole series of moves and record them for future replay.

Catch the beat of the street with Break Street. For individual or team play. New from Creative Software.

$24.95

The answers are at your finger tips.

What's the capital of Alaska?

Roll Call USA

Do you know? Get ready to outwit your family and friends with Roll Call USA's fun facts on states,capitals and major industries.

Roll Call USA combines history and geography facts into a colorful question and answer game that challenges your knowledge of the 50 states, their capitals, major industries and statehood dates.

Feel confident? Drill yourself with a Flash Test. The game is speeded up, so think fast. Your answers are tallied up at the end for a final score.

Roll Call USA, a game of USA trivia for team or individual play. For Commodore 64. New from Creative Software.

$14.95

Call and order today! Use your Visa, MasterCard or personal check. Toll Free **1-800-331-7990** (outside California), **1-800-448-1001** (in California), or **1-408-745-1655.** MONEY BACK GUARANTEE. If not completely satisfied, return within 10 days for full refund.

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February 1985 Vol. 3, No. 2

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THE EDITOR'S *notes*

I am writing these notes on a distinctly non-winter day in early December. One could argue that the strangeness of this Christmas computer sales season is weather related, and perhaps that argument has as much merit as any of the others. The reality is that our selling season this year is a mere ghost of Christmas past, and (many argue) bodes poorly for Christmas future. Has the home computer market vanished? We're firmly convinced, in spite of sales figures to the contrary, that it hasn't. We may have collectively stumbled or slowed, but the industry, in a state of collective gyration, has its bright spots.

Early reports are that the Commodore 64 continues to sell quite well, thank you, notwithstanding the awaited debut of the Commodore Plus/4 and 16. Retailers are in a somewhat confused state, not quite sure what to push, what to pull, etc. We're seeing direct evidence of that confusion at the book retailing level.

Naturally, IBM's PCjr would pick a season such as this to begin a surge in popularity. Feedback we're getting indicates that retailers have had a very hard time keeping up with demand for the package IBM launched in early November. It's refreshing to see some market segment struggling to meet orders. The crunch, as verified in *Wall Street Journal* stories almost daily, continues to reach less visible groups.

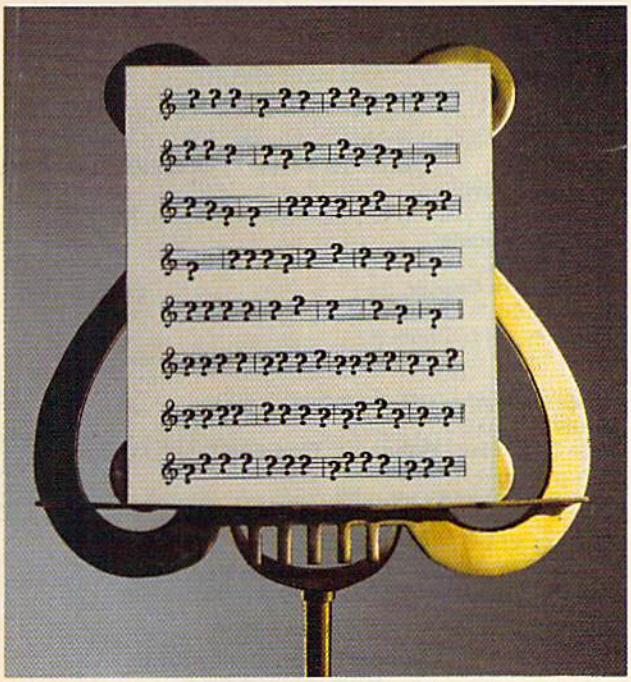
We've seen layoffs at software houses, shake-ups in sales forces, shrinking manufacturer budgets, and even evidence that such diverse suppliers as disk drive manufacturers are now falling victim to the shakeout. Since last we wrote, the slow-down has continued, and at this point the industry-critical Christmas rush has failed to materialize in size.

So where do we go from here? Is it over for the industry? Are we going to return to being a hobbyist fad? We think not. The millions of you who own and use home computers will be, in large part, responsible for the next wave of growth. Out of your ranks will come the software, the enthusiasm, the reality-based vision of computing that will make personal computing a durable reality. We're sure of it.

Robert Lock

Editor In Chief

Compose music, even if you can't read a note.



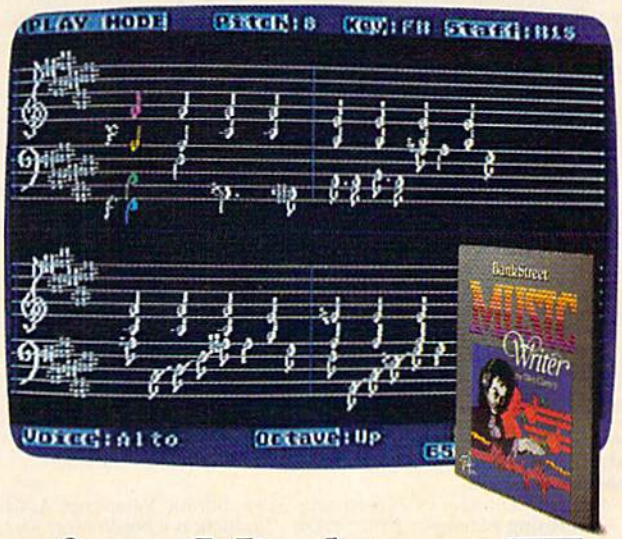
With the Bank Street MusicWriter by Glen Clancy, you compose by computer.

It's so simple, people who don't know a pianissimo from a pizza can start composing in less than an hour.

All you do is match the sound that you hear in your head. And the MusicWriter writes it down.

But don't be fooled by the simplicity. It's not a toy. It's a tool.

In fact, MusicWriter has everything you need to compose a serious symphony. It has repeats, endings and triplets. It has articulation and transposition. It can shape tones, store 75 staffs, and play up to 4 voices.

But even if you don't know what all that means, it won't stand in your way. Because if you can hum a tune, you can write a tune.

Bank Street MusicWriter from Mindscape

Compatible with Atari® and Commodore.® Mindscape, Inc., 3444 Dundee Road, Northbrook, Illinois 60062.

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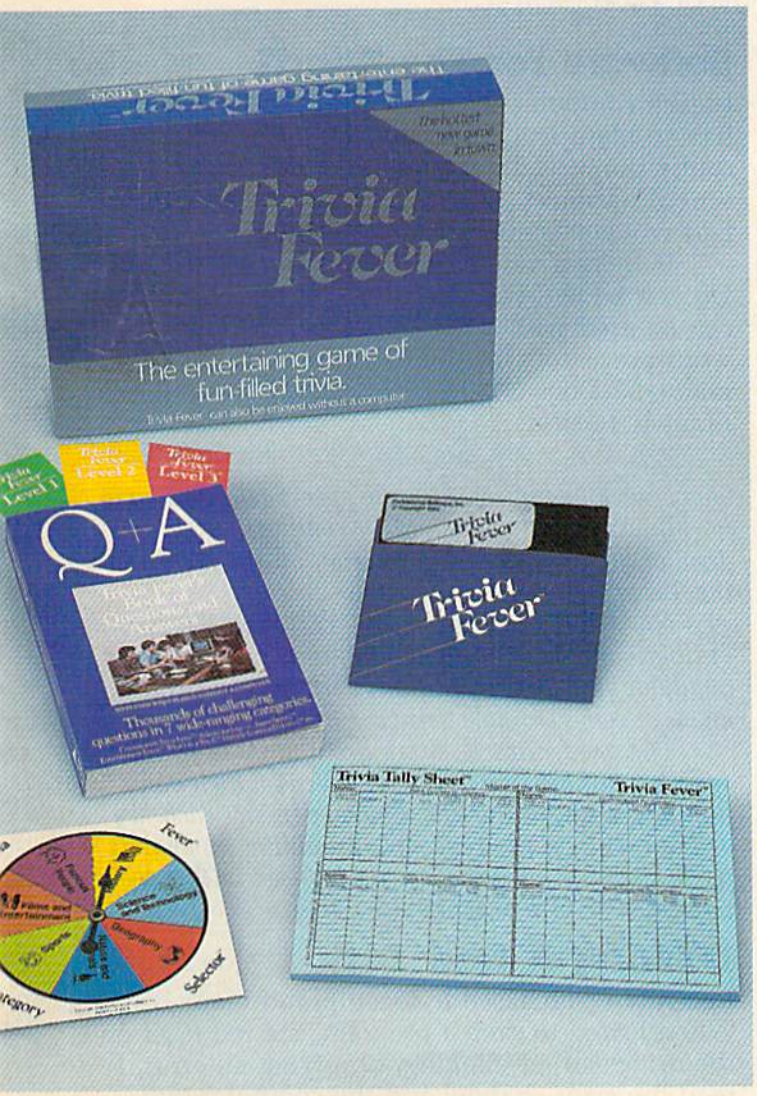

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GAZETTE FEEDBACK

EDITORS AND READERS

A Time-Saver

I am new to programming on the 64. The other evening I was working on a program when my wife (a professional programmer) came in to assist me. She came to the following four lines:

```
60 IFLEFT$(K$,1) = "A" THEN 200
70 IFLEFT$(K$,1) = "S" THEN 400
80 IFLEFT$(K$,1) = "M" THEN 600
90 IFLEFT$(K$,1) = "D" THEN 800
```

She typed the first line, hit RETURN, then cursored back up to the line, changed the line number, cursored through the line making the two changes, then hit RETURN. She then repeated this procedure for the remaining two lines.

I understand how this would work, but at the time I was very surprised. I think your readers would like to know about this timesaver.

John Stetar

You've discovered a handy feature called onscreen editing, *which can save some time. It's helpful when you're entering several similar lines, or when you make a mistake you have to correct.*

In general, every time you press RETURN over a line, it's entered into memory. If there's a number in front, your computer assumes it's a line number, and adds it to the program in memory. If there's no line number, the statement is executed immediately.

Some computers require that you go into a special edit mode before fixing a line. You might have to type EDIT 100 to correct a mistake you made in line 100, for example. Onscreen editing makes things a lot easier. You simply cursor up to the line and fix it. And if you give it a new line number, it's added to the program in memory.

Foolproof Typing

I would like to know how to make Proofreader checksum numbers for programs which don't appear in COMPUTE! or COMPUTE!'s GAZETTE.

Tim Sitkiewicz

If you're writing your own program or typing one from another magazine, Proofreader numbers won't be able to tell you if it's correct or not. The logic of Automatic Proofreader doesn't apply to the line you type unless you (or someone else) already have a correct version of the line.

The programs published in the GAZETTE *are fed into another program that adds up the ASCII values of the characters in the line, to generate a checksum. You can't start with a checksum and have the computer figure out what the line should be (Proofreader numbers range from 0 to 255, but there are many more than 256 different BASIC lines). Nor can you figure out what a checksum for a line should be, unless there's a correct version of the line to begin with, in which case you wouldn't need a checksum.*

Software For The Blind?

I teach computer science at a high school and have a blind student in my class. His father recently purchased a Commodore 64. At the school, we have a word processor called *Braille-Edit* which runs on an Apple computer.

Is there a version of *Braille-Edit* for the 64? Do you know of any software for the blind that can be used with a 64? Do any of the current word processors for the 64 come with Braille manuals? Does COMPUTE!'s GAZETTE come in a Brailled version?

Linda S. Lamb

Sorry, we know of no software specifically designed for blind users of the 64. Most computer programs display the important information on the screen of the TV or monitor.

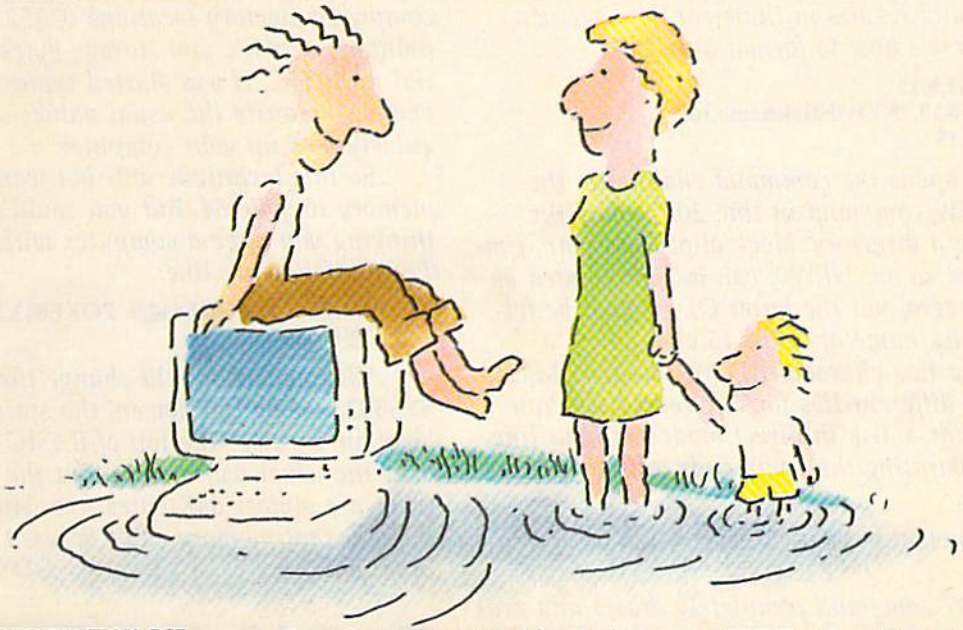
Nor have we heard of any word processors with braille manuals. And the GAZETTE *is not currently available in a Braille edition. Perhaps our readers know of some suitable software for the blind.*

The good news is, there are a number of good speech-synthesis programs for the 64 which can pronounce English words. Some even say each key as it's typed on the keyboard, providing immediate feedback. Such programs could be used with a word processor or in a programming class.

NEWing A New Disk

Recently I purchased a dozen brand-name disks. When I tried to save a program, the red light on the drive started blinking, signifying an error. I read the error channel and the computer said "Drive Not Ready." I tried all twelve disks and

GET YOUR FEET WET...



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got the same results. At first I thought it might be the disk drive, but I have no problems at all with the demo disk included with the 1541.

Are some disks incompatible with a Commodore system or am I overlooking the obvious?

Kathy Gauvin

An eight-inch disk is incompatible with a 1541 disk drive, because it is too big for the door. But that's probably not the problem.

The demo disk works, so it would seem that you have a working 64 and disk drive. It's possible, but unlikely, that you got a bad batch of disks, in which case you could return them to the manufacturer or to the store where you bought them.

More than likely, however, you probably didn't format the disks. Saving to an unformatted disk won't work, and results in the error message you described. Here's how to format a disk:

```
10 OPEN15,8,15
20 PRINT#15,"NEW0:diskname,id"
30 CLOSE15
```

Line 10 opens the command channel to the disk. The NEW command in line 20 formats the disk, creating a directory, block allocation map, timing bytes, and so on. NEW0: can be abbreviated as N0: (that's a zero, not the letter O). It must be followed by a disk name of up to 16 characters, a comma, and a two-character ID for the disk. Make sure you use different IDs for different disks. You can also format a disk in direct mode (without line numbers), separating the commands with colons, as follows:

```
OPEN15,8,15: PRINT#15,"N0:MYDISK,AA":
CLOSE15
```

The NEW command completely erases any programs that might have been on the disk, although brand new disks are blank to begin with. Once the disk is formatted, you can save and load programs.

Copying GAZETTE Programs

My friend subscribes to COMPUTE!'s GAZETTE, just like me. Since we have both purchased it, isn't it OK for him to give me a copy of a program he typed in? Why should I spend hours typing it when he already did?

Todd Wolfe

It's fine for your friend to give you a copy of the program, as long as each of you subscribes to the GAZETTE *or has bought the magazine the program appears in. But you cannot legally make copies for people who have not bought the corresponding issue. Nor can you legally make copies of the programs and sell them.*

Unusable Memory

I think I may have come across a way to get more memory out of a Commodore 64. Typing POKE 642,0: SYS 58260 displays the usual opening message, except there are 40959 BASIC bytes free. Is this actual BASIC memory?

James Wolfe

That combination of POKE and SYS resets some pointers for the start of BASIC. The equivalent SYS on a VIC is 58232. The technique can be very useful if you want to reserve some memory for machine language or custom characters. You can safely subtract memory from BASIC (by POKEing a number larger than 8 into 642 before the SYS), but the POKE and SYS can't be used to add memory. Here's why:

What you've done is put the start of BASIC down in zero-page. There's real memory there, but it cannot be used for a BASIC program. Zero-page comprises memory locations 0–255 and is full of pointers, vectors, and storage bytes which are essential to BASIC. If you started typing in a program, it would overwrite the usual values and would very quickly lock up your computer.

So this technique will not work to add BASIC memory to your 64. But you could fool a friend into thinking you have a computer with "extra" memory. Try the following line:

```
POKE641,1: POKE642,0: POKE643,255: POKE644,255:
SYS58260
```

VIC owners should change the last command to SYS58232. The line lowers the start of BASIC to location 1, raises the top of BASIC to 65535, and does the usual warm start. But the screen will say there are almost 64K bytes free. Unfortunately, though, that memory can't be used for a BASIC program.

The Not-So-High Cost Of Telecommunications

I own a VIC-20 and have just purchased a VICmodem. I know how to hook it up. My question is, do I have to pay outrageous amounts of money to join certain services to use my own modem? Please list specific services as well as their rates.

Walter Kimbrough

There are three different ways to use a modem and, generally, only one will cost you money.

First, you can call a friend who owns a modem, and type back and forth or upload and download programs.

Second, you can sign up with a local bulletin board system (BBS). Most are free, but a few have a minimal membership fee. They're often sponsored by a user group or a computer store. Call a few computer stores in your area and you're likely to find the phone numbers of some local boards. Once you log on to a board, chances are good you'll find messages about other BBS's in your area, and across the country.

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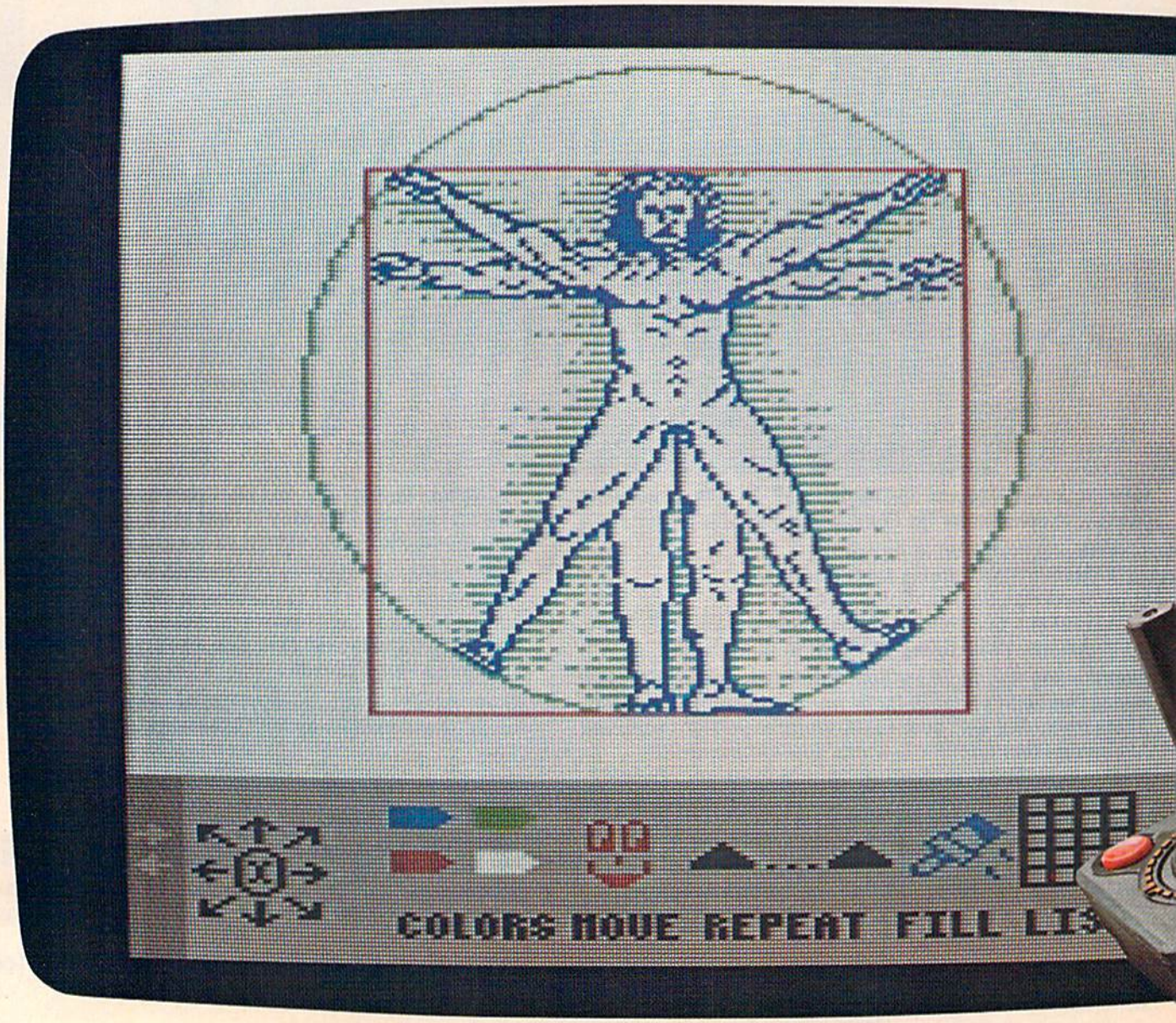
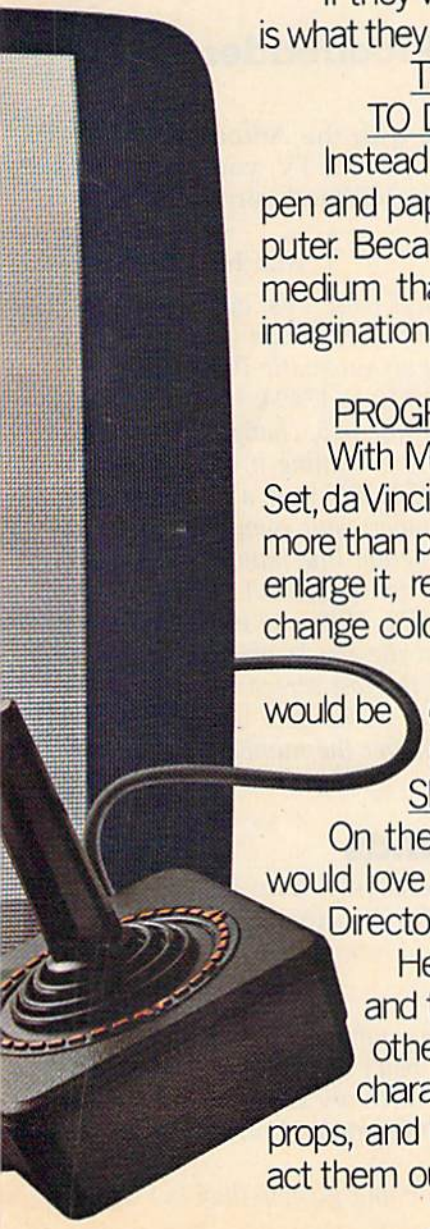


grams for kids that eare, Dickens and ve loved.



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There are an estimated 4000–8000 BBS's currently operating in the United States.

Bulletin boards have a curious life cycle. Usually someone who owns an auto-answer modem decides to start one, sets it up, and posts messages on other boards as publicity. Since there are not any members yet, there aren't many messages either. Most start out as free boards—anyone who calls can join immediately at no charge. If a lot of people become members, more messages and discussions build up, which attracts more members. As the popularity increases, it becomes more and more difficult to get through—you can expect to hear a lot of busy signals calling a popular service.

A bulletin board that begins as a no-cost board may start charging a membership fee when it becomes too popular, to compensate for the time of the sysop, and to cut down on the number of calls (a lot of callers, like yourself, don't like to pay for telecommunications).

It's not feasible to publish the phone numbers of 4000–8000 bulletin boards in the GAZETTE, *especially considering that many might not be around tomorrow or next week or next month. We know of one area code in California which had over 50 bulletin boards at last count.*

You should realize that a no-charge board doesn't cost anything, unless it's out of town. Long distance charges (whether they're voice connections or bulletin board calls) can add up quickly. You don't pay for signing on to the BBS, but the phone company gets its share.

The third way to use your modem is to sign up with one of the major services: CompuServe, The Source, Dow Jones, or Delphi (expect more to sprout up as telecommunications becomes more popular). You'll generally pay a connect fee, $6 or more per hour, depending on the time of day and baud rate. Most big services charge more during business hours (8–5) and 1200 baud sometimes costs more than 300. Some, like CompuServe, have numerous entry points—local phone numbers in cities of 50,000 or more—so you can avoid long-distance charges.

The charges for local and national BBS's are subject to change, of course, and even if you find $6 per hour too expensive, there's a good chance you can find a free board in your city or area.

Reading Datassette Keys

Is there any way to determine whether the keys (record, play, rewind, fast forward, stop, eject) on the Datassette are being pressed?

Jackson Moore

You can't read the individual keys, but you can use a PEEK to find out if the motor is on (or about to be on).

Bit 4 of location 1 on the 64 can tell you whether a key on the cassette drive is pressed. A value of zero means record, play, rewind, or fast forward is down. You can use (PEEK(1)AND16) to check this bit. If it's value is 16, the buttons are turned off. If it's zero, one of the four buttons is pressed. You can't tell which button is pressed, only that one of them is.

On the VIC, the equivalents are (PEEK(37137)AND64), and (PEEK(37151)AND64). You can check either 37137 or 37151 to see if a button is pressed on your Datassette. If the result is equal to 64, the Datassette is off, and if it's zero, the Datassette is on.

The WAIT statement can make the computer temporarily stop until a button is pressed:

```
WAIT 1,16,16 (64)
WAIT 37137,64,64 (VIC)
```

If you want the program to wait until the button is off, use:

```
WAIT 1,16 (64)
WAIT 37137,64 (VIC)
```

VIC owners can substitute 37151 for 37137 in either of the lines above.

Lowering The Proofreader Checksum

Just one thing is wrong with the Automatic Proofreader. When you have a TV, you can't see the number in the upper lefthand corner. Is there a way to fix this?

Matthew Speakes

This problem does not affect most TVs, but if you can't see the Proofreader number, it can be fixed.

First, load your copy of Automatic Proofreader. Change the 17539 in line 110 to 17494. In line 970, change 018 to 013 and in line 976, change 058 to 018. Save the new program before running it. If you make this change, don't press RETURN over a line with the Proofreader checksum number; your computer will think you've entered a program line number.

An alternate solution for the 64 is to POKE 53265,31 before typing RUN. This may move the screen low enough to read the checksum number, although you'll lose part of the last screen line.

If you have a VIC, try POKEing a number larger than 25 into 36865. The larger the number, the farther down the screen moves.

Wedge Commands

I use the 64 wedge extensively. I would like to hit one key and have the directory list. What POKEs do I need?

David Lee

While the wedge is working, type @$ or >$ and the directory will list. And it won't affect any program currently in memory. The directory is read from the disk (but not loaded into memory) and printed to the screen.

The commercial-at (@) and greater-than (>) signs

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are used to send commands to the disk drive. >R0:FINAL=TEST, for example, takes a program called TEST and renames it to FINAL. Use @ or > without a command to read the error channel. The left arrow key, above CTRL, is used to save programs to disk. To load a program from disk, type a slash (unshifted question mark) followed by the program name. The up-arrow key loads and runs a program from disk.

Readers not familiar with the wedge can find it on the demo disk which is packaged with the 1541 drive. A short BASIC program loads the wedge and starts it running.

Software/Interface Problems

I am one of those apparently rare ducks who has chosen not to buy a Commodore printer, in favor of a letter-quality RS-232 printer. But I cannot easily find programs offering an RS-232 option. I've bought an assembler/monitor to look at machine language programs, but still have not been able to redirect printing commands to device 2.

Warren W. McCurdy

There are a few things you can do, but attempting to make changes to a machine language program should be your last resort.

Some programs will never work on a letter-quality printer. A high-resolution screen dump program usually works by addressing individual dots on a dot-matrix printer. Your printer doesn't have any such dots, and won't recognize the hi-res information.

But most good word processors should let you input the type of printer you're using and the device number (an RS-232 peripheral is device 2). It may be necessary to do some POKEs before you run the program, to set the baud rate (the speed at which the computer sends signals to the RS-232 channel) and other parameters. You may also be required to print in "true ASCII," rather than Commodore ASCII, sometimes called PETASCII.

If the software documentation omits information about using an RS-232 printer, or the information is unclear, write or call the company that publishes the software. Many software publishers have excellent customer service departments, which can answer questions like yours. And contact the manufacturer of the printer and interface, describing the software and how you have your computer, interface, and printer hooked up. A user group, too, may be able to help.

Some RS-232 printers (Brother, for example) have two interface options: RS-232 or Centronics. There are Commodore-to-Centronics interfaces available with an emulate mode--which makes your printer act as if it were a real Commodore printer (with some exceptions, like high-resolution plotting).

If all else fails and you are an intermediate to advanced machine language programmer, you could try making modifications to the program. First, read the section about the RS-232 port in the Programmer's Reference Guide. Then find the section about the Kernal routines. Three of them are used to open a channel—SETLFS, SETNAM, and OPEN. Use the hunt or search option in your ML monitor to find all instances of JSRs to those routines (assuming the software calls the Kernal routines). For example, JSR SETLFS would translate to 20 BA FF. Searching through a disassembly is difficult. You may not be able to make the necessary modifications.

Perplexed By Duplex

I would like some information on the difference between half and full duplexing. I read about it in your November issue, but am still not sure what duplexing means.

Scott Orr

Most bulletin boards and information services operate in full-duplex, so you can generally leave your modem and software set for full-duplex.

Normally, pressing a key on the keyboard puts a character on the screen of your TV or monitor. The operating system polls the keyboard and decides what needs to be done (print a letter, stop the program, clear the screen, etc.).

But if you call a bulletin board in full-duplex, the software in charge reads the keyboard and sends a series of beeps over the phone line. It does not print anything on the screen.

At the other end of the phone line is a computer receiving the beeps you just sent out. It translates the beeps and then sends them right back to you. Your computer hears the beeps and, finally, prints the character on the screen, based on what came over the phone line. Every time you type something, it makes a round trip to the other computer and back to yours before being printed on the screen.

If your terminal software is set for half-duplex, the character does not make a round trip, the letter or number is sent through the phone lines and also prints to the screen (directly from your computer). This can cause ddoouubblleedd lleetteerrss if the bulletin board thinks you're in full-duplex and automatically echoes all your characters.

There are two advantages to full-duplex. First, you know the bulletin board received your message because every character goes full-circle. If there's electronic noise on the line, garbage appears on the screen. Second, when you log on and type a password, it can be made invisible (passwords are not echoed back), in case someone is looking over your shoulder, trying to get a peek at your password.

Just Numbers In Memory

One day I was going to work on one of your MLX programs. I entered the POKEs, loaded MLX, and typed 2049 and 6842 for beginning and ending addresses. I then used the display

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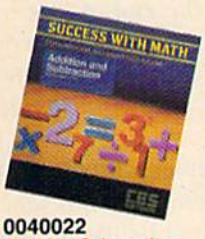


0040022
Addition/Subtraction
0041012
Multiplication/Division
Both available for C-64, Atari H.C. and Apple: *disk*.

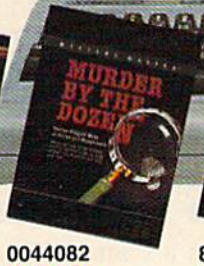
8035022
Zaxxon
Adam, C-64: *cart*; Atari H.C.: *disk and cart*; Apple: *disk*.

8172052
Master Type
C-64, Atari H.C.: *disk and cart*; Apple: *disk*.

8230052
Run For The Money
C-64, Atari H.C. and Apple: *disk*.

8122062
Pitfall II
Adam, Atari H.C.: *cart*; C-64: *disk and cart*.

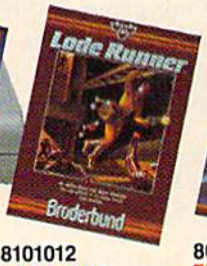
8100022
Choplifter
C-64, Atari H.C.: *disk and cart*; Apple: *disk*.



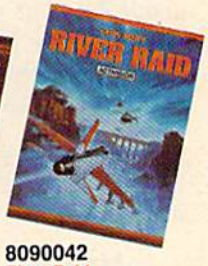
0044082
Murder By The Dozen
C-64, Apple: *disk*.

8123052
Bruce Lee
C-64, Atari H.C. and Apple: *disk*.

8216032
Seastalker
C-64, Atari H.C. and Apple: *disk*.



8101012
Lode Runner
C-64, Atari H.C.: *disk and cart*; Apple: *disk*.



8090042
River Raid
C-64: *disk and cart*; Atari H.C., Adam: *cart*.

8105072
Zork II
Atari H.C. and Apple: *disk*.

8104082
Zork I
Atari H.C. and Apple: *disk*.

8150012
Summer Games
C-64, Atari H.C. and Apple: *disk*.

8149052
WarGames
Adam: *cart*.

8102002
Temple of Apshai
C-64, Atari H.C. and Apple: *disk*.

8215042
Beach-Head
C-64, Atari H.C.: *disk*.

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command, just to see what would happen. I saw a machine language program until line 5223. I saved the mysterious ML to disk, turned off the computer, and loaded the program. It was the BASIC MLX program. How did a machine language program turn into BASIC? Can you clear things up?

Peter Chu

Either MLX was already in memory when you did the POKEs, or you mistyped the POKEs. You saw MLX looking at itself. And then you used MLX to save MLX.

Some computer users have the misconception that machine language (ML) is a series of numbers POKEd into memory, while BASIC is made up of letters, numbers, and other characters. They're right about ML, but not about BASIC. A BASIC program may look like letters and numbers on the screen, but in memory it's numbers, just like machine language.

The following short program illustrates:

```
10 REM 12345
20 X=PEEK(43)+256*PEEK(44):X=X-1
30 FORJ=0TO16:PRINTJ;J+X;PEEK(J+X):NEXT
```

Make sure there's a space after the REM in line 10. Type RUN (it works on the 64, the Plus/4 and 16, or a VIC with any memory expansion). You'll see three columns of 17 numbers. Line 20 figures out where BASIC starts and line 30 PEEKs at the first 17 bytes of the BASIC program.

*First there's a zero. Zeroes mark the divisions between lines, although they can be used for other purposes as well. There must also be a zero in the first byte, before the program starts. The next two bytes are the line link, a pointer to the next line of BASIC. On a 64, for example, you'll see a 13 and an 8. Type PRINT13+8*256 and the result is 2061 (where the next line starts). Note the zero in 2060, marking the end of the first line.*

*Next you'll see the line number, in low-byte/high-byte format, a 10 and a 0 (10+0*256 is 10). If you were to POKE an 11 into the low byte and LIST the program, you'd see that line 10 has been changed to 11.*

Now the BASIC program begins. 143 is the token for REM. The three letters of REM have been condensed down to a single number. When you type RUN, BASIC uses this number to look up the corresponding BASIC command. Tokens are always numbers between 128 and 255. When the operating system sees this number, it looks up command 143 (REM) and finds that it should skip over the rest of the line. The computer looks for a zero, marking the beginning of the next line. If you typed LIST, it would look up the spelling of command number 143 and find the three letters R, E, and M. They would then be printed on the screen.

POKE a 153 into the location currently holding a 143, and LIST the program. You should see that REM has been transformed into PRINT, because 153 is the token for PRINT.

Next is a 32, the ASCII value of a space, followed by 49, 50, 51, 52, 53. These five numbers, too, are ASCII values (for the characters 1–5). On the twelfth line you see a zero, marking the end of line 10. The next two bytes are the line link, again. The line link from line 10 pointed to the line link for line 20 (which in turn, points to the next one). And the 20 and 0 are the line number.

You could continue PEEKing memory, seeing how a BASIC program is changed into numbers, until you found a zero (marking the end of a line) followed by a line link of two zeroes. Three zeroes in a row mark the end of the program.

The numbers in memory are just numbers. They could be a BASIC program, an ML program, or variables of some kind. You and the computer decide how they'll be interpreted. Type RUN and the computer assumes there's a BASIC program in memory. SYS makes it begin executing a machine language program.

The Loop Doesn't Work

I own a Commodore 64 and am experiencing inconsistent results with FOR-NEXT loops when the step increments are not integers. For example, FORX=1TO55STEP6: PRINTX: NEXT works, but changing it to FORX=.1TO5.5STEP.6 (dividing everything by ten) does not. Here are the results of the two loops:

```
 1   .1
 7   .7
13  1.3
19  1.9
25  2.5
31  3.1
37  3.7
43  4.30000001
49  4.90000001
55
```

Whole numbers work as expected, but not fractions. Not only does 5.5 not appear on the list, but what gives with the extra digits? Using real numbers in loops is a vital part of a program I am working on.

Richard Lake

Imagine a person counting up to ten by thirds. But before beginning, the person (who doesn't know how to add fractions) converts 1/3 to .333 and finishes with 9.99 instead of 10. The result is incorrect and you can blame the laws of math for not allowing 1/3 to be translated into a decimal fraction.

Your computer is like that person who can't add fractions. Base ten numbers like .6 or .1 have to be translated into their binary equivalents in floating-point format before any math is done. You won't have problems with numbers like .5 or .25, because they are made up of powers of two. But other numbers may contain a slight inaccuracy. As you add up the numbers, the inaccuracy grows larger and larger, leading

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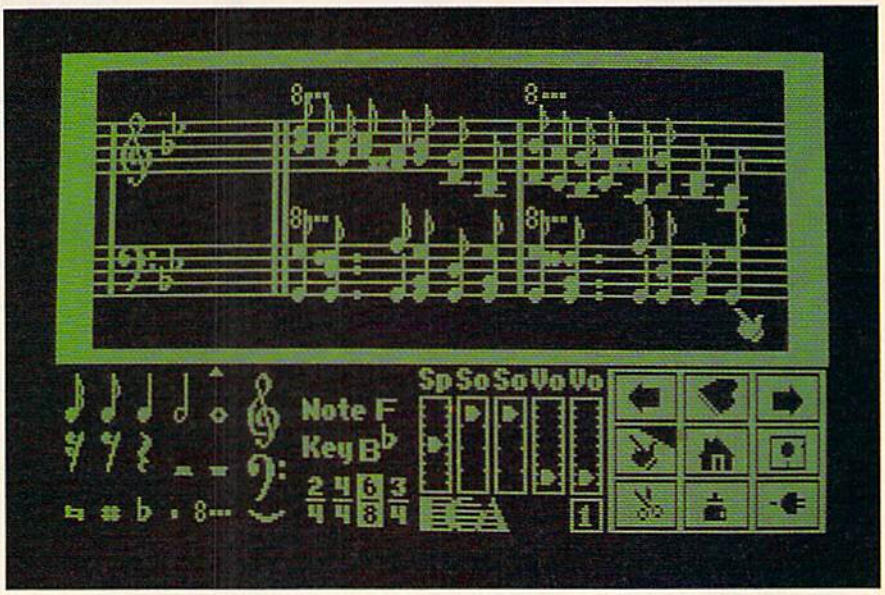

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That's you at the right end of the staff of notes – the little hand. Move the joystick, and you move the hand. Use it to carry notes up to the staff. Lay in rests, signatures, clefs, then point to the little piano in the lower right and listen, because you'll hear the whole thing played back.

Move those little scales in the middle up and down to vary the music's speed, sound quality, and volume. Use the scissors to cut out whole measures, then use the glue pot to paste them in somewhere else. Got a printer? Great. Print the score out and show it off to your friends.

But what if you're not up to writing your own stuff yet? No problem. There are twelve pieces of music already in here, from rock 'n roll to baroque. They're fun to listen to, and even more fun to change. (Apologies to Mozart.)

The point is, the possibilities are endless. But if you're still skeptical, visit your nearest Electronic Arts dealer and do the one thing guaranteed to send you home with a Music Construction Set in tow.

Boot one up. Point to the piano. And listen.

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to numbers like 4.30000001.

As you have noted, whole numbers aren't subject to rounding errors. Integers can always be expressed as a binary number; your 64 translates them correctly into base two.

The same type of problem is encountered with all computers which use floating point numbers (including the Apple and IBM). Atari computers, however, use a format called Binary Coded Decimal *(BCD). BCD is more accurate, but can be slower than floating point. A BCD number can also take up a lot more memory than a floating point number.*

One way to fix your FOR-NEXT loops would be to use Binary Coded Decimal. It's available on the 64, but only in machine language, unfortunately.

There are a couple of simple BASIC solutions. Since integers are accurate, use only integers in loops:

```
FORX=1TO55STEP6:PRINTX/10:NEXT
```

This solution may not be entirely acceptable, depending on what you want your program to do. If you must have fractional step sizes, try this:

```
FORX=.1TO5.5STEP.6: X=VAL(STR$(X)): PRINTX:
NEXT
```

By changing the number to a string, and then taking its VALue, you effectively eliminate the slight inaccuracies. They're still there, but they don't add up. You may find it takes a little longer to complete the loop, but the results will be more accurate.

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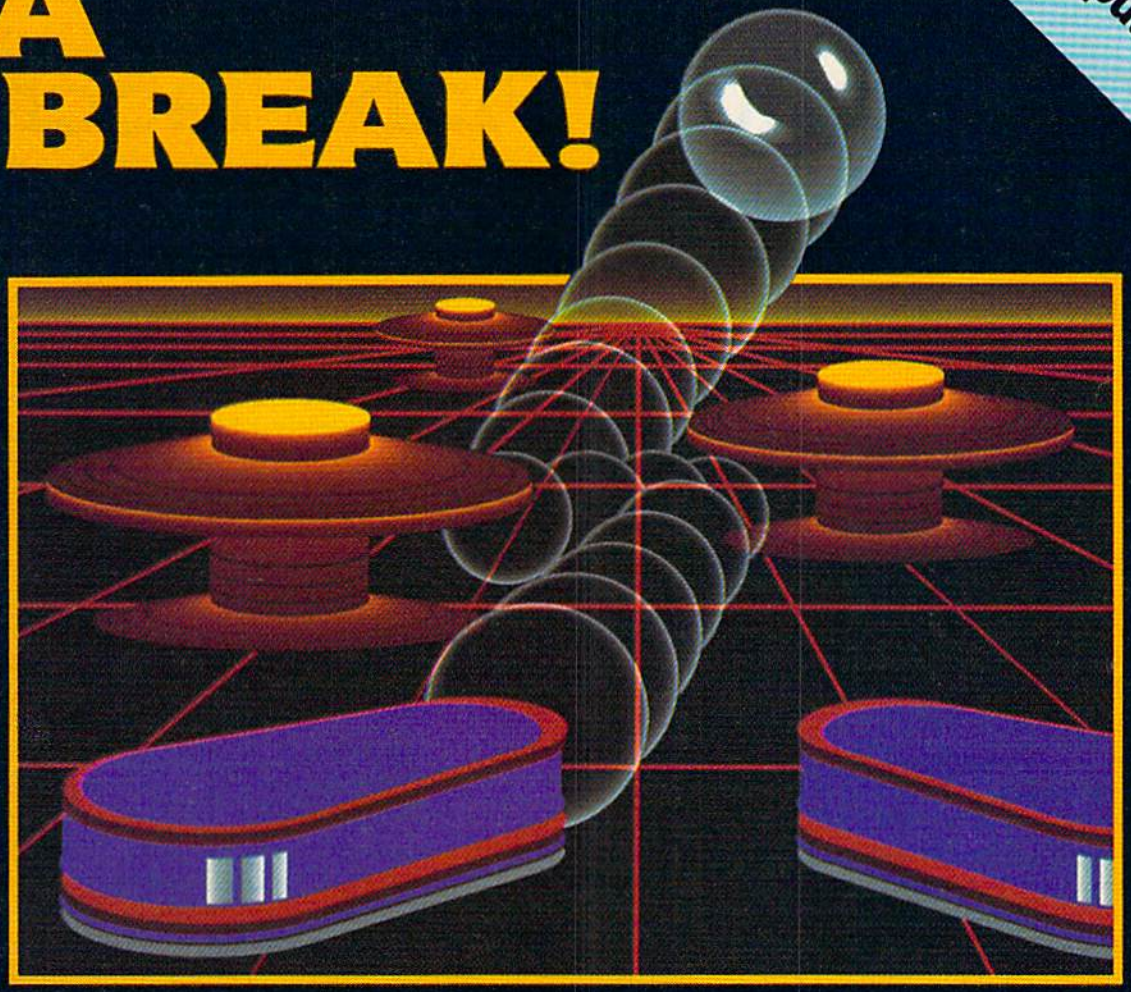

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The Computer Piano Teacher

Fred D'Ignazio, Associate Editor

When I was a kid, I asked my parents for piano lessons on my eighth birthday. It was one of the biggest mistakes of my life.

The piano lessons completely changed my attitude about the piano. Before the lessons began, I had banged on the family piano every day. But, after my lessons began, I played less and less often, until, by my ninth birthday, I only played two days a week: the day before my lesson and the day of my lesson. All the other days I stayed as far away from the piano as I could.

Playing For The Teacher

Why the big change? Before I started taking lessons, I was playing the piano for myself. After my lessons began, I was playing for the teacher. I played what she wanted me to play, how she wanted me to play, and when she wanted me to play it. I was on her schedule, not mine, and I resented it terribly.

But since I couldn't articulate my resentment at the time, I took the easy way out and became perverse. I "forgot" to practice. I "forgot" to show up on time for my lessons. I "forgot" my sheet music. I suffered through endless ailments that affected my fingers and hands. I complained of blurry vision, pains in my lower back, and even spent one summer trying to sneeze my way through every lesson.

I must have been pure torture for the endless stream of kindly women who had the misfortune of becoming my piano teacher. They would lecture me, harangue me, plead with me, and beg me to practice, but I never did. And instead I wasted their time and my time for six long years before my parents finally gave up and discontinued my lessons.

I was 14 when I stopped taking piano lessons, and in the 22 years since I stopped taking lessons, I've probably only sat down at the piano ten times.

Catie's Turn

Now my nine-year-old daughter Catie is interested in the piano, and she wants my wife and me to let her start taking lessons.

How can I explain to Catie that piano lessons killed my interest in the piano and smothered whatever ability I had to become a decent musician? How can I tell her how angry I am at myself, my parents, and all those poor innocent piano teachers? All I know is that when I see that Catie is interested in the piano, I am very, very wary.

1001 Ways To Play "Heart And Soul"

What makes it worse is that Catie is just like I used to be (before the lessons): She is a piano addict. She comes in from school every afternoon and heads straight for the piano. When she walks by the piano room door, she always slips into the room and plays a few bars of her favorite song, "Heart And Soul." In fact, she plays the song incessantly. We hear it early in the morning, late at night, and all day long on weekends.

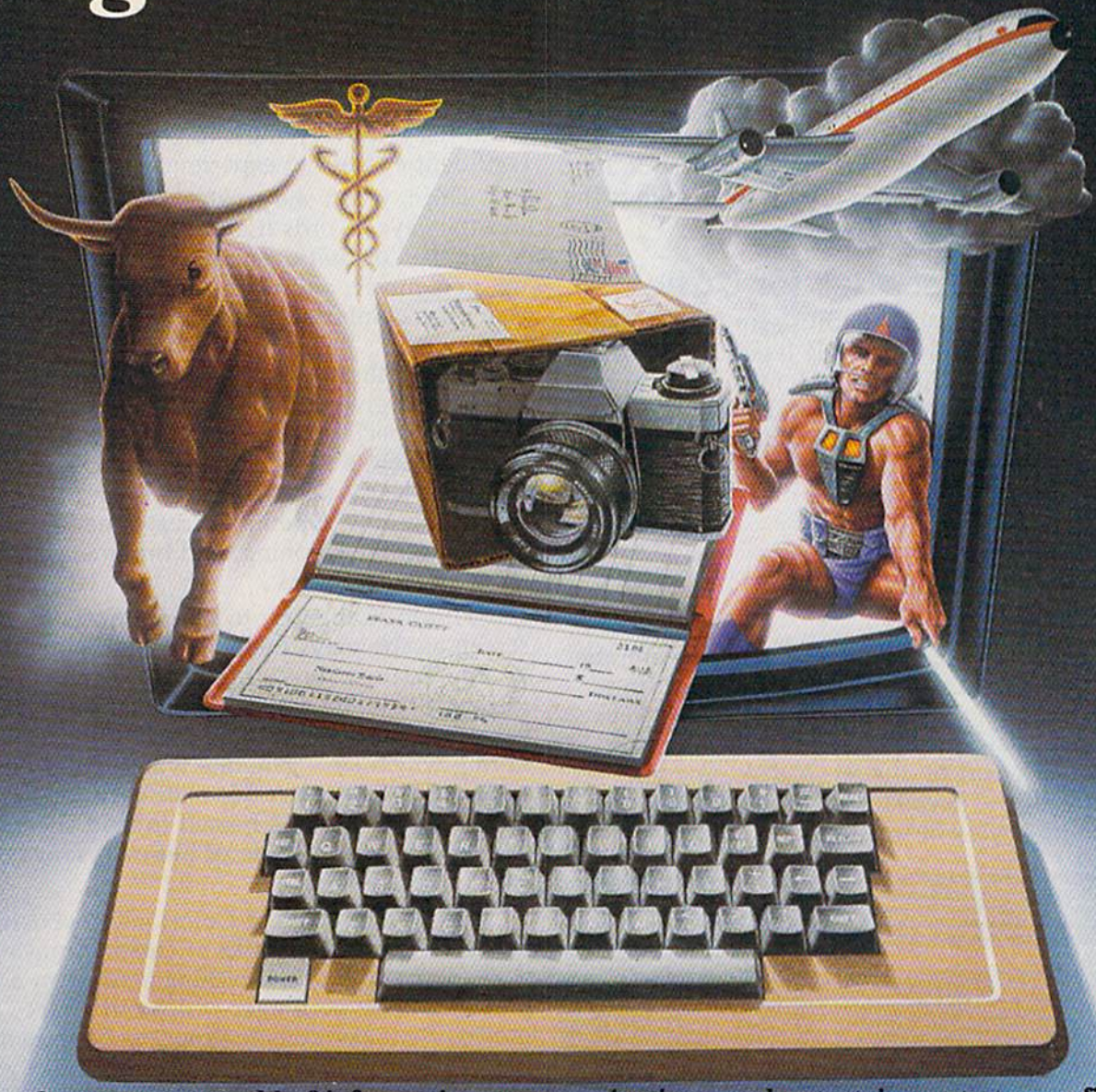
Catie doesn't play the song mechanically. Instead, she has become a "Heart & Soul" virtuoso. She plays it fast. She plays it slow. She plays it several octaves too high. She plays it several octaves too low. She reverses the chords. She adds new chords. She plays it (at last count) 23 different ways. And she adds a new variation every other day.

My wife Janet and I have heard "Heart And Soul" so many times, in so many ways, that we are climbing the walls. When Catie slips into the piano room and begins banging away, my wife and I sprint from the kitchen or study and slam the door shut. We are desperate parents.

Catie is driving both of us crazy. Yet we are very proud of her. We submit to this daily torture willingly because we value Catie's interest in the piano and her originality and experimentation.

We may soon invest in a couple pairs of extra-thick ear muffs, but we will not tell Catie how to practice, when to practice, or what to

We don't care which computer you own. We'll help you get the most out of it.



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practice. We've made it clear to her that the piano is her project, and what she does on the piano is her business.

Interviewing Piano Teachers

We have thought about getting Catie a piano teacher. About two months ago, I interviewed five piano teachers, and finally gave up. All of them looked and sounded like my old piano teachers. They wanted Catie to play the same kinds of introductory pieces. They emphasized sight-reading and other mechanical skills in place of musical enjoyment, creativity, and originality. They didn't seem the least bit interested in Catie's interest in arranging and composing music. And they had no plans to teach Catie about the wider cultural and historical dimensions of music. Instead, the lessons would consist of 30 minutes a week of learning only those things the teachers wanted Catie to learn.

A Special Teacher for Catie

I could imagine Catie's enthusiasm for the piano drying up after only a couple lessons. So I said good-bye to the teachers, and, instead, went out and bought a special piano teacher for Catie—the Colortone Keyboard. The keyboard works with our Commodore 64; it costs $79.95 and is available from:

Waveform Corporation
1912 Bonita Way
Berkeley, CA 94704
(415) 841-9866

The Colortone Keyboard is a flat membrane (touch-sensitive) plastic keyboard, measuring 9-1/2" by 15", with two octaves of piano keys and 14 special-function keys. It plugs into the first joystick port on the 64. A disk program comes with the keyboard and must be loaded before the keyboard will work.

Catie uses the keyboard to do six things she cannot do by herself on the piano. First, she plays the rainbow-colored "Touch Harp" strip above the piano keys and creates beautiful sequences of notes like waves breaking on a shore. Freeing her from pressing the individual keys on a regular piano keyboard enables her to create melodies based on many more notes and from more complex patterns of notes.

Second, when Catie creates her own music, certain keys are masked and are not playable. This helps her create songs that sound good without a great deal of painstaking effort. It's like putting Catie on a pair of musical roller skates. She creates songs twice as quickly as she does on a piano because she can play more notes easily (with her relatively short fingers), and she feels confident enough to experiment.

Third, when she creates a new song, she almost always records it and saves it to disk. Later in the day, or that evening, we hear Catie creating new music, and we hear a "recital" of songs Catie has composed, played, and recorded earlier in the day.

This ability to recall music she made earlier has helped give Catie a historical, or comparative, perspective when creating new music. Now she can browse through songs she created yesterday or last week, and relate them to what she is creating now. Often she creates new songs by borrowing, refashioning, and ornamenting portions of earlier songs.

Fourth, Catie gets to see the notes on the screen as she plays them. This has helped her get an appreciation for "written music" as opposed to music that she makes up herself or plays by ear. Catie has learned how to sight read music by noting which keys generate which notes on the screen. She has taken this skill back to the piano, where she is teaching herself to read sheet music and to copy down some of her own songs onto sheet music paper.

Fifth, thanks to the Colortone Keyboard and software, Catie now looks at creating music the same way she looks at writing a story on a word processor. She no longer whips out a piece of music, then abandons it, going on to something new. Instead, she edits, plays, and fiddles with everything she creates. She chooses from 12 musical scales and changes the scale of the piece up or down. She chooses from eight musical instruments and shifts back and forth between instruments. She speeds up the tempo of the music, or slows it down. And she fixes on certain bars in the music that she really likes, and she plays them over and over (like "Heart And Soul"). Later, she uses these bars as musical "ideas" in her new songs.

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Last, she is developing a real sense of rhythm from strumming, tapping, and sliding up and down the harp strip and from synchronizing her own playing with the 12 preprogrammed songs that come with the Colortone software.

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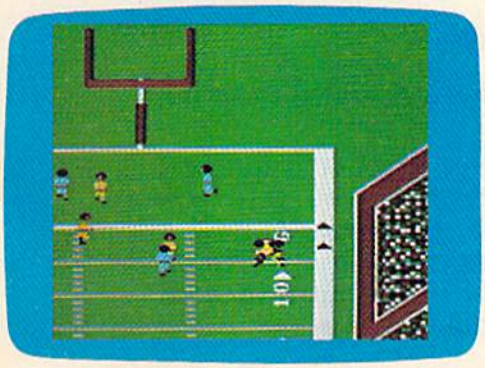

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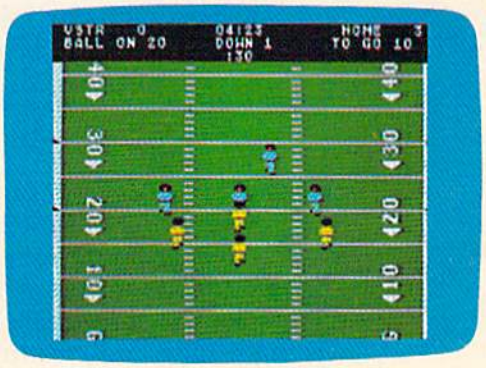

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Commodore 64 MUSIC For Non-Musicians

Kathy Yakal, Feature Writer

It doesn't matter whether you've ever touched a musical instrument, or think "timbre" is something you yell when a tree falls. New music software and keyboards now available for the Commodore 64 are creating a world of music you can participate in even if you're untrained or inexperienced in music.

The theory may not yet be confirmed by research, but it seems that a lot of people who like computers like music. The act of writing a song and creating a computer program are not dissimilar; both involve taking a multitude of individual notes or commands that by themselves are unimpressive and combining them to create a cohesive whole.

Not everyone who likes music is a musician, and many computer owners have no interest in programming. Rather than compose their own songs or software, they buy the compositions of others.

"Three out of four people who buy traditional musical instruments quit after their fourth or fifth lesson," says Bill Moulton, technical director at Waveform Corporation, a California company which produces music hardware and software. "Lots of people have dusty musical instruments in their closets."

And lots of people have computers, machines which are capable of producing musical sounds. As computers have simplified other tasks, many people see them as potentially powerful music machines. "I've seen studies done by major corporations that say 70–90% of the people would like to make music on their home computers if it was made easy," says Moulton. "The *if it was made easy* part is the crucial factor."

Thanks to companies like Waveform, it *is* becoming easy.

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Musical instruments have no time to get dusty if their owners are even casual musicians. Mastering an instrument takes more than understanding theory and learning to read music. Training your lips to play a note on a trombone, or your fingers to strum a guitar chord, requires a lot of physical ability and daily practice. And to do those things well can take years.

Small wonder, then, that so many people quit. "And once someone uses an instrument and can't get it right, there is a stigma. They won't pick it up again," says Moulton. To make music accessible to those people, "You've got to provide something that is both a lot of fun and entertaining and jumps all those hurdles that everyone thought was associated with learning music in the first place.

"The computer can jump the hurdles, like calculators helped kids learn their times tables. Teachers were afraid that they wouldn't learn them as well, but studies showed that those kids learned faster. Not that the computer should take the place of learning those skills, but it helps people not get discouraged, people who love music and have an ear for music and can hum a tune or whistle."

Waveform created the *Colortone Keyboard* ($79.95) to help jump those hurdles. It's a touch-sensitive membrane keyboard with 25 piano-like keys (two octaves), a touch strip that performs as a musical harp, and 14 function keys. Using the accompanying software, the function keys allow the user to choose from eight different instrument sounds (by touching the desired note on the keyboard or any spot on the harp) to play along with any of the 12 songs included.

A musical staff displaying the composition's notes scrolls by on the screen as the song plays. At the same time, a piano graphic shows which notes the user is playing. If the user wants to compose a tune, the background song can be turned off. Everything can be saved for later playback.

"When you sit down to play *Pacman*, at the lowest level you won't get shot out of the sky right away," says Moulton. "You have a little bit of a cushion, though you may not win the first time."

The same should be true with musical instruments, he believes. You shouldn't get shot out of the sky. "People are pretty shy about doing things that allow them to express themselves, whether it's sports or something like music. People just want to know if they have talent. This way, if they do, they can get encouraged right away. And if they're inspired, they'll go on and learn more."

For more advanced music applications, the *Colortone Keyboard* can also be used in conjunction with the *Musicalc* series, Waveform's well regarded music software.

Think for a minute. Can you hum the tune Commodore uses in its television ads? A lot of their advertisements stress the music capabilities of the Commodore 64, and well they might: The SID chip is still the most sophisticated sound chip available on any home computer, largely

Sequential Circuits' keyboard for the 64.

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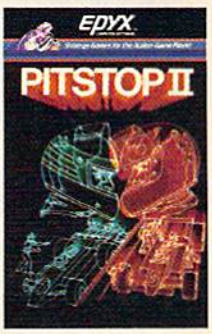

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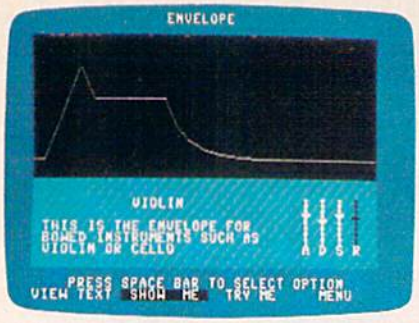
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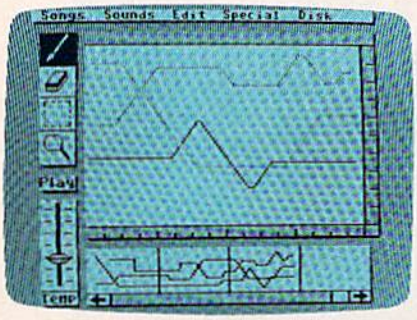
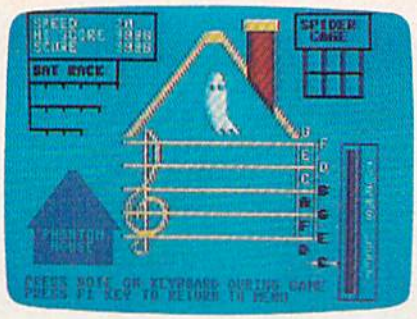


Passport's MacMusic *uses a Macintosh-style screen display to make composition simple.*



DesignWare has introduced the first package in its Music Teacher series. The Notable Phantom *teaches children to recognize notes on a musical staff and match them with the corect note on a 1½ octave plastic keyboard overlay. Above is one of the package's three games. If the correct note is played in time, it turns into a bat and flaps its way back into the bat cage. A songbook containing 20 familiar tunes is included. (Suggested retail for keyboard and software is $49.95.)*

due to its three-voice, nine-octave range and its independently programmable features. What the commercials don't tell you is that you'll have to learn a couple dozen POKEs just to get a single note. The appeal of the new musical software is that it takes care of all the POKEs, freeing the computer owner from the petty programming details.

"A lot of Commodore owners were influenced to buy because of its musical capabilities," says Chris Albano, vice-president of marketing at Passport Designs, another company producing music software and hardware for the Commodore 64. "Our main goal is to bring as many musicians and non-musicians into using their Commodore for music as possible."

Passport is perhaps best known as the first company to ship MIDI (Multiple Instrument Digital Interface) software. MIDI, fast becoming an industry standard, allows synthesizers and drum machines to be hooked up to each other and to personal computers. It's still primarily for a professional market because of the cost of the keyboards, though Passport manufactures interface cards for the Commodore 64 and Apple II.

For non-musicians, Passport has designed *MacMusic* ($49.95), its first consumer product. *MacMusic* features a Macintosh-style user interface, which features easy-to-use pull-down menus and icons. Using a joystick, you "draw" melodies on the screen and shape your own compositions, or modify popular pre-programmed tunes.

"It's a much easier way to look at music," says Albano. "Pitch goes up when the line on the screen goes up, and notes hold longer because they last longer on the screen."

If you want to be a good composer, however, you'll still have to study. "More than anything, programs like this make music easy to create," says Albano. "Music theory won't change. Digital technology just allows people to have easier access."

Computer Hitware ($19.95) is the first result of Passport's joint venture with Hal Leonard Publishing Corporation. Each disk in the series contains songs from groups like Duran Duran, The Police, and Bruce Springsteen. And you can do more than just sing along: You can create your own rock video by rearranging the screen graphics.

"As the technology increases, you can see the whole video and audio thing becoming one medium," says Albano. "Someone will be able to sit down with a synthesizer and a video machine and create a piece by themselves. That's much more of a multimedia event than watching four guys from London play guitars. The audience is going to become much more sophisticated—their eyes and ears will demand much more complex stimulation."

"Up until a year ago, there really wasn't any good music software for the Commodore 64," says Joe Billings, vice-president for marketing and sales at Sight & Sound Music Software. A 20-year-old music publishing company, Sight & Sound decided to start publishing music software about two years ago.

"We saw music being a new application for computers," says Billings. "I'll be honest with you: I'm a 30-year-old guy and I play games on my computer at home."

Billings believes that most people buy computers and then wonder what they can do with them. "We're hoping they can say, 'Oh! It's also an incredible musical instrument.' "

The problem with some music software, he says, is that you're using the computer keyboard instead of a regular piano

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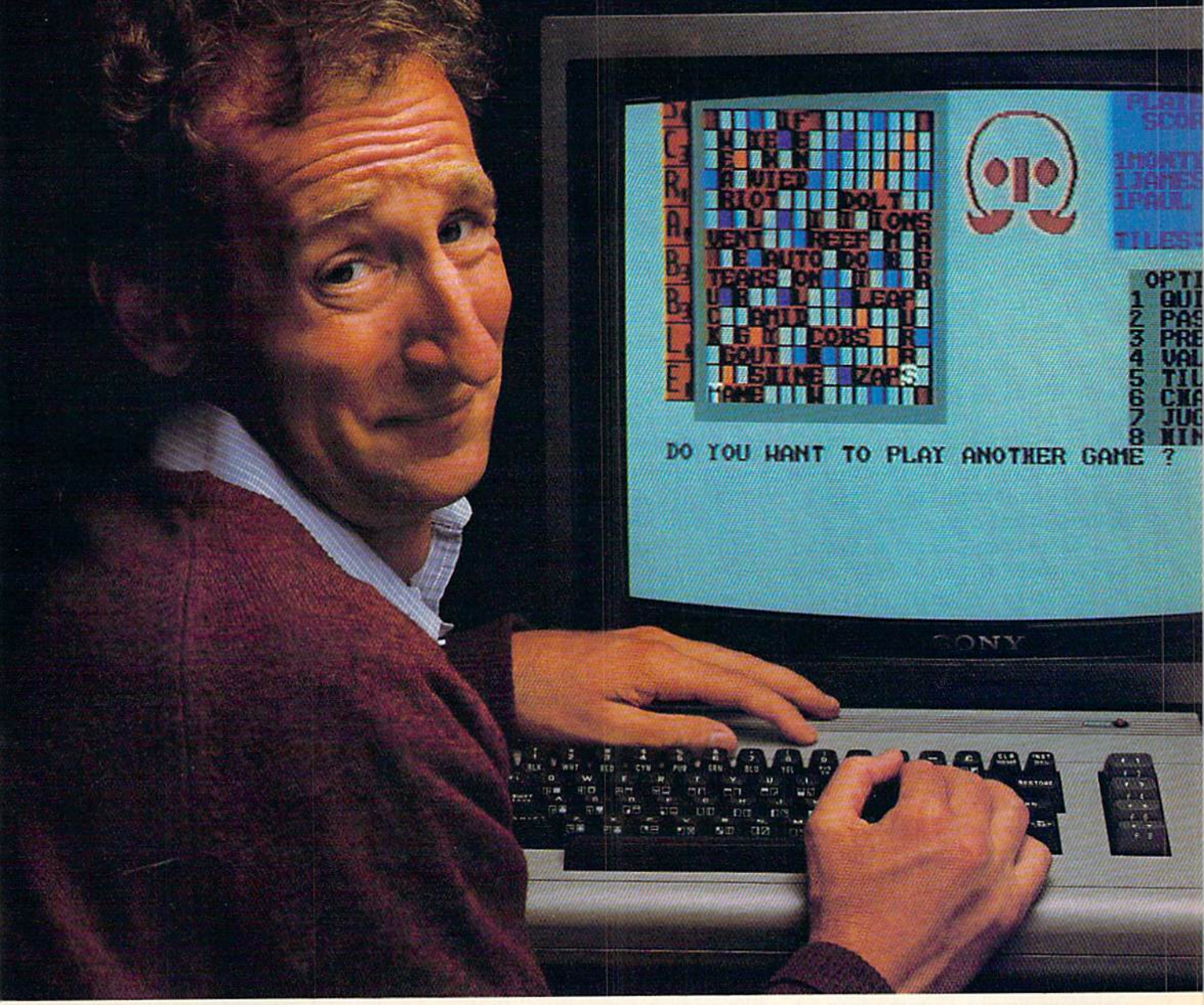

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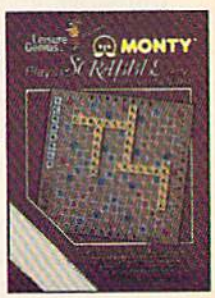

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keyboard, so you don't necessarily hit the key corresponding to the note you want to play. "That doesn't teach you music. Once you have a keyboard, you turn the computer into a legitimate musical instrument."

To that end, Sight & Sound has released the *Incredible Musical Keyboard* ($49.95), a package which includes a two-octave plastic keyboard overlay that fits over the top of the Commodore 64's keys, plus software which lets you perform a variety of musical options. Pressing one of the piano-like keys activates the computer key beneath it.

Sight & Sound enlisted jazz guitarist Ryo Kawasaki, among others, to help design software for the *IMK*. This software series, ranging in price from $29.95 to $49.95, includes the *Kawasaki Synthesizer*, which transforms your Commodore 64 into a programmable synthesizer and sound processor; the *Kawasaki Rhythm Rocker*, which creates space sounds and high-resolution graphics to the beat of electronic rhythms; the *Music Processor*, which lets you create, edit, record, and play your own musical compositions; and their latest, *3001: A Sound Odyssey*, a complete music tutorial. Their new *Music Video Kit* lets you create your own music videos. (See a review of the Sight & Sound music software elsewhere in this issue.)

"The problem we have now is that the technology is there on the very high end—expensive synthesizers that you can hook up to your personal computer—but you need a $500 interface and drum machine," says Billings. "On the low end, you have some excellent software.

"The next step is really going to be the person who comes out with a sound source or a peripheral keyboard with electronics to expand voicing capability. The price is going to have to be around $200. Once that happens, it's like adding a printer, it's like adding a disk drive, it's like adding a monitor." Both Passport and another music company, Sequential Circuits, are expected to have relatively inexpensive keyboards available for the Commodore 64 by the time you read this.

In the next two or three years, Chris Albano believes, the sounds in personal computers themselves are going to be phenomenal—real violins, real trumpets, real voices. "They're bringing the sounds onto very small chips, digitally recorded. It's only a matter of time before these computers have tremendous sound capability, and that's when you're going to see music software really expand in terms of what it can do."

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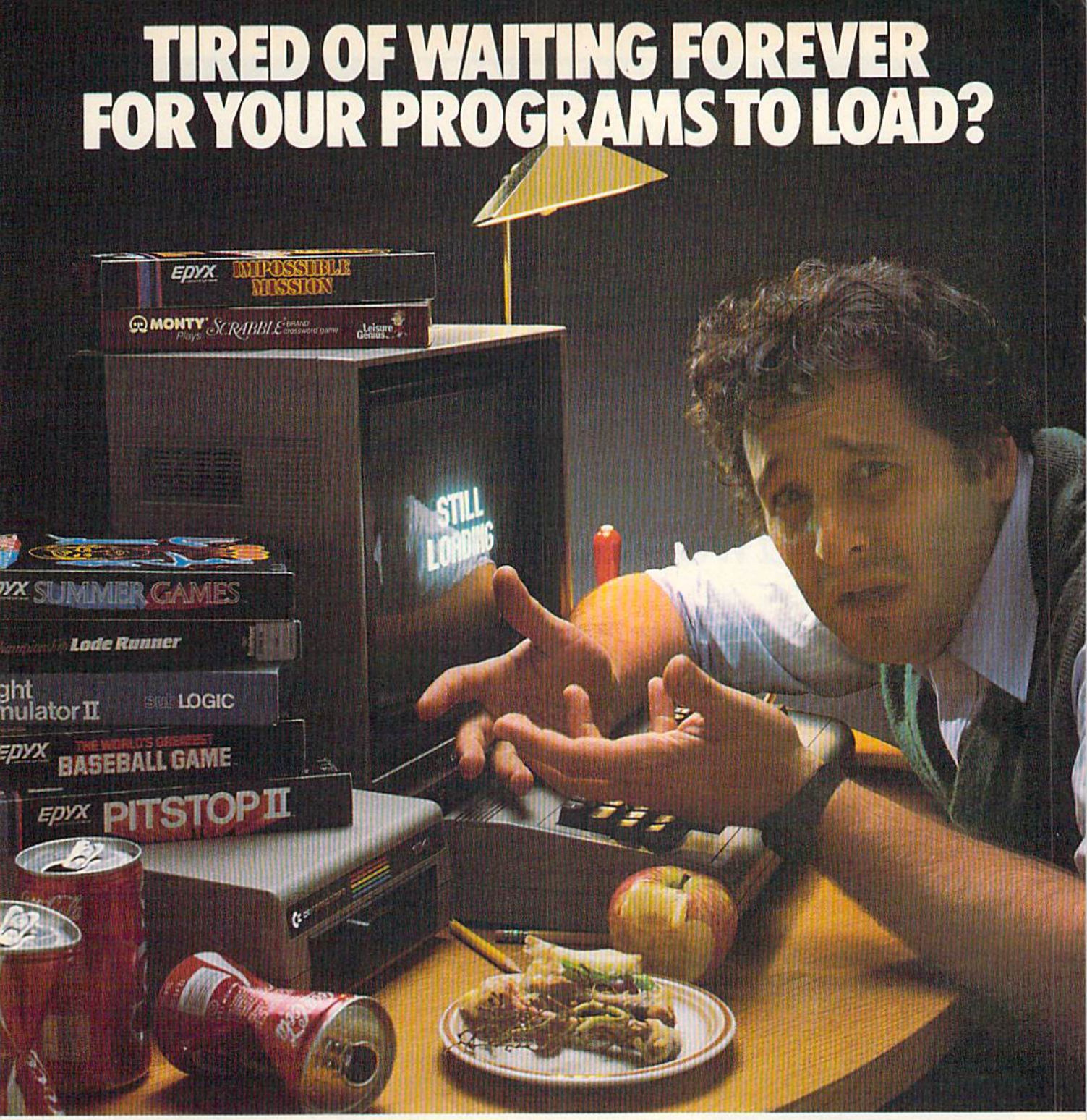

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Ryo Kawasaki, The Designer Behind The *Kawasaki Synthesizer* And The *Kawasaki Rhythm Rocker*

Sharon Darling, Research Assistant

A fascination with new technology coupled with a desire to expose non-musicians to the joys of synthesized music led jazz artist Ryo Kawasaki to develop two versatile music programs for the Commodore 64: the *Rhythm Rocker* and the *Kawasaki Synthesizer*.

Ryo Kawasaki stood in a Manhattan computer store two years ago and had to argue with a salesman about buying a Commodore 64. Yes, he said, I'm sure. That's the computer I want.

What the salesman couldn't know as he talked to the slender Japanese-born jazz musician with the physics degree and 13 albums to his credit, was that Kawasaki had a vision. "I was interested in introducing what a synthesizer could do to the mass of non-musicians, so they would understand and enjoy synthesized music."

And what better computer to achieve that than the inexpensive Commodore 64 with its remarkable Sound Interface Device (SID) chip? Three months after buying his 64, Kawasaki emerged with his first programming effort—*The Composer*. That original concept has now been expanded and refined into two music packages for the 64, the *Kawasaki Synthesizer* and the *Kawasaki Rhythm Rocker*, part of a series of integrated music programs marketed by Sight and Sound Music Software, Inc.

Understanding and enjoying music through a computer symbolizes for Kawasaki the underlying Japanese interpretation of music itself. "In Japanese, the music is done by two letters—one is the sound, and the second is the joy, or pleasure. It is two characters, so a joy and a pleasure of the sound is music. Music is not like notating a note or writing a score—that comes later. First you have to enjoy the sound, and that was my interest in the Commodore 64," he says.

Kawasaki saw the 64 as a good tool to bring music to the masses because of its programmable filter as well as the SID chip. "To me, the filter is the most important thing in making synthesized sound," he adds.

The *Rhythm Rocker* and *Kawasaki Synthesizer* were designed to be easy enough for children ages six and up to operate. But the programs offer enough depth, variety, and flexibility to challenge and delight adults no matter what their musical backgrounds. With the *Kawasaki Synthesizer*, which comes on two disks, users have two sequences from which to choose—the performer and the composer.

In the performer section, you can choose from eight different screens, allowing you to see a demonstration of songs written with the synthesizer; special keyboard effects, such as glissandos, vibratos, and slides; and a visit to "Kawasaki's Space Dance Theater," where the star performers, the Kicker Brothers, kick-box in time to the music.

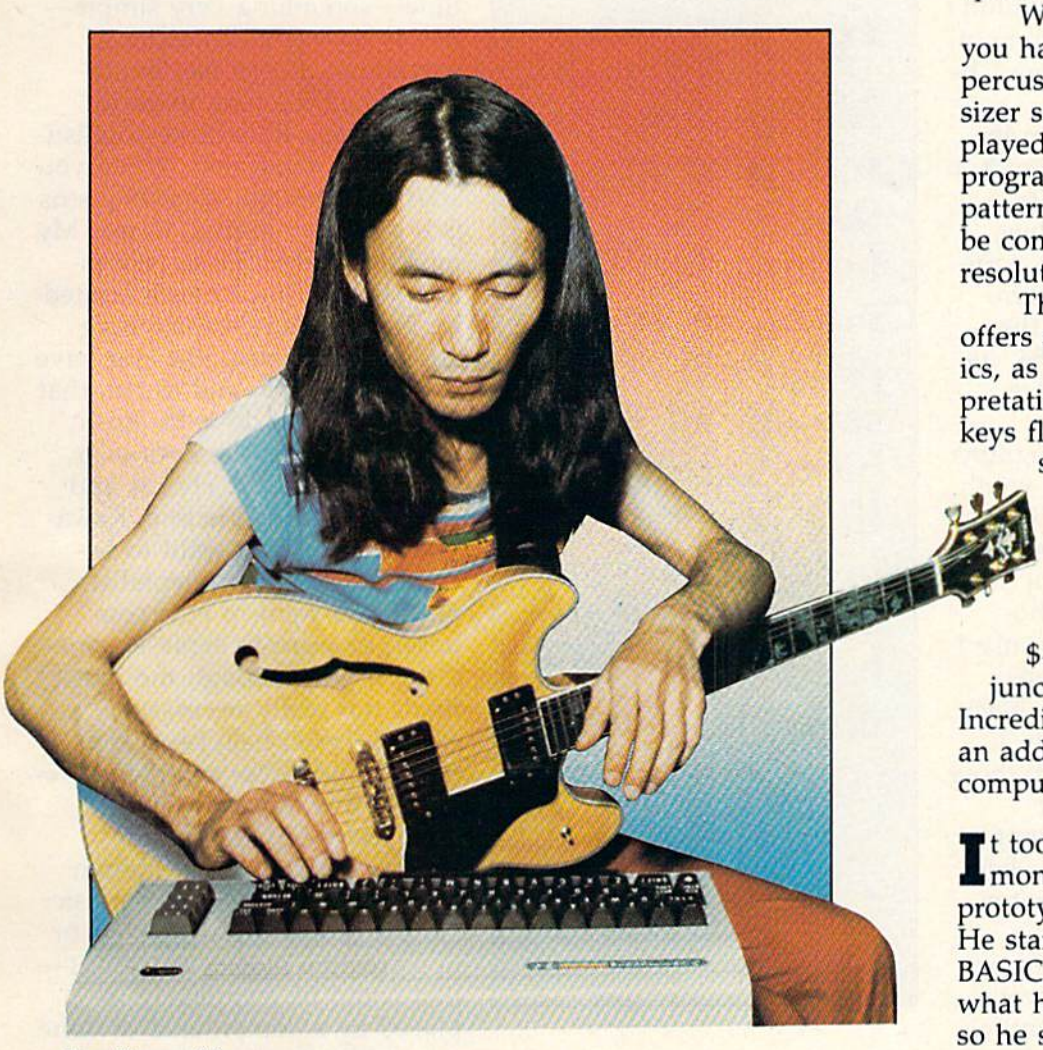
In the keyboard mode, users can choose from 21 different sounds, ranging from organ, piano, and trumpet, to more exotic ones, such as space travel, outer space, waves, gun shots, or mystery sound. By pressing another key, the waveform and octave can be changed to create more than 500 different sounds. Pressing B adds a bass and rhythm line to your composition.

The sounds are accompanied by graphics—keys on the screen change color to represent different notes being played, while cartoon characters tap their feet in time to the music. (For more detailed information, see the review elsewhere in this issue.)

The composer sequence has four different screens, and three-track recording capabilities. A sound editor can be used also to create an unlimited number of instrument sounds and special effects.

With the *Rhythm Rocker*, you have a choice of electronic percussion, bass, and synthesizer sounds. Melodies can be played and recorded over preprogrammed bass and rhythm patterns, and compositions can be complemented with high-resolution graphics.

The demonstration mode offers stunning geometric graphics, as well as a graphic interpretation of a keyboard, with keys flashing on and off the screen as notes are played. Both the *Rhythm Rocker*, which retails for $39.95, and the *Kawasaki Synthesizer*, which has a suggested retail price of $49.95, can be used in conjunction with Sight & Sound's Incredible Musical Keyboard, an add-on overlay for the computer.



Ryo Kawasaki

It took Kawasaki about four months to come up with the prototype of his two programs. He started out programming in BASIC, but found it too slow for what he wanted to accomplish, so he switched to machine language. "Machine language is much easier than BASIC because I have been involved with electronics and hardware all my life, and it's just much easier to understand and to change, to transfer and to enhance," Kawasaki says.

That was his first encounter with computer programming. He demonstrated the prototype at a computer store in New York, and the owners liked it enough to start selling it. Within

two weeks, about 30 copies were sold, he recalls, "So I said 'Oh, maybe I can do something with it.' I started rewriting it, and I finished it in about July or August of 1983."

However, he didn't have as much luck with his second version of *Composer*. "I was looking for different people to sell the program, but everybody was more interested in a word processor or games, and they didn't have as much understanding of music programs at the time," he says.

A trip to an exhibition in Japan in the fall of 1983 led him to the people from Sight & Sound, who liked what they heard. They asked him to write a simpler version of the composer, which turned into the synthesizer. In March 1984, he started work on the *Rhythm Rocker*, finishing it in June.

The design of the programs harks back to Kawasaki's youth, when he first became interested in music. "I wasn't interested because [I was exposed to] Stravinsky or Mozart or Beethoven—I was interested because I had one of those toy pianos with a songbook, and the black keys were only painted on. I didn't even know what all those things stood for." He just wanted to see what different kinds of sounds he could elicit from his one-octave range toy, he remembers.

"That kind of experience got me into music," he recalls. "So my focus with the synthesizer is to get down to that level—so non-musical that even little people [children] can just play and express themselves, and you don't have to know anything—just enjoy the graphics and press some characters."

Most of the functions on his programs can be accessed by pressing only one key, to make operation even simpler, and to get down to the main purpose of the programs: to make music.

But the programs' simplicity doesn't mean serious musicians can't benefit from the programs, says Kawasaki. "I'm a very serious musician, and I've been into electronics and synthesizers for a long time, and somebody else like that wouldn't mind having this program. I wouldn't expect how much they could seriously use it, but it would be something they could have." He has used his Commodore 64 on some of his albums, and in some of his concerts, especially to create sound effects.

> **"My mother wanted me to take piano lessons, but I never wanted to, because that is something you have to learn, like you have to learn to type, and to me, that has nothing to do with music."**

Learning music with a computer might be more interesting to a child because it takes away one of the more frustrating elements of learning a traditional instrument, such as a piano or trumpet—tedious practice sessions just to learn notes and basic patterns. To Kawasaki, the main point of playing a musical instrument should be to express something you feel inside.

"When I started playing [as a child], I played the ukelele or the harmonica or recorder or toy flute—something very simple—but at least you can express something. If you feel limitations, then it's time to go to something a little more sophisticated or complicated. When you start that though, what happens is it gets very boring, to me. My mother wanted me to take piano lessons, but I never wanted to, because that is something you have to learn, like you have to learn to type, and to me, that has nothing to do with music."

Just hitting the keys over and over until the chords and notes are learned is fine, Kawasaki says, "if you want to become a great instrumentalist. But if you want to be a composer, or want to express something in you through the music, that's not really necessary."

Kawasaki believes a computer could never completely replace a live musician, but he does feel there are definite applications for a non-human instrumentalist. "Session music, like for (commercial) jingles, or non-creative music, as I call it—that could be completely replaced by a computer. I've done a lot of jingle sessions, and they don't need you, they just need your skill," he says.

However, he adds, "there is a creative and expressive music that should always have the artist." When he uses rhythm machines or synthesizers, he says, "I would rather program them to do something a human being could never do—I would approach it as a new instrument, a new discovery, rather than trying to play something a human

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being could play, because a human being has a certain quality, and a computer has a certain quality."

The jazz music he performs, both solo and with his band, Golden Dragon, is perhaps the hardest form to replace with synthesized music, since much of the final outcome depends on improvisation and interaction between the members of the band, Kawasaki says. Composing for popular songs adapts more easily to synthesizers and computers, he adds, because "anything that can be done in written music can be very easily adapted to computer music, but if something is not in that area, like in jazz, it still requires a lot of human qualities."

Kawasaki approaches software writing the same way he approaches music—as a composer. "It is almost exactly as when I compose music and when I perform instruments," he says. "I have some artistic goal I want to achieve while I am developing the software. What 'artistic' means, to me, is it has some feeling in the presentation of yourself, which communicates with other people's feelings, and that's a primary connection between the programmer and the people." That feeling, he hopes, will inspire creative energy among users of his programs.

Kawasaki is currently working on another program for the 64, a score writer. However, he says he doesn't know if he will finish it or not. For the past two years, he has been devoting his time to the computer, and he says he'd like to get back to recording albums and doing concerts. "I've been making music for 20 years, and I've only been computing two years, so I would like to get back to music, and take a little rest from the computer until some new hardware comes out," he says.

His inspiration comes "from seeing some new toy. I don't get inspired because I like programming. I see a new toy, and I see how far I can go with this little toy, and that occupies me for a couple of years, and I do something, and then I wait until something else comes up."

Besides computers, anything scientific and creative interests Kawasaki, who came to the United States in 1973. The 36-year-old Tokyo native, who makes his home in an artists' building in New York City, opted for a career in music rather than physics because "I found it [physics] a little quiet, underground kind of thing. I like to be a little more flashy—I like to go out in front of people and express myself."

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SIMPLE ANSWERS TO COMMON QUESTIONS

TOM R. HALFHILL, EDITOR

Q A

Each month, COMPUTE!'s GAZETTE *tackles some questions commonly asked by new Commodore users and by people shopping for their first home computer. If you have a question you'd like to see answered here, send it to this column, c/o* COMPUTE!'s GAZETTE, *P.O. Box 5406, Greensboro, NC 27403.*

Q. Could you tell me which computer monitors are compatible with the Commodore 64? I intend to use my computer for word processing in 80 columns, but still would like the monitor to also display the standard 40 columns. I know a monochrome monitor is needed to display 80 columns of text clearly, but does an 80-column monitor also display 40 columns? And does a green-screen monitor work with the color Commodore 64? I need some type of monitor to reduce eyestrain.

A. Generally speaking, any monochrome or color monitor with standard *composite* input should work with your Commodore 64 (or nearly any computer, for that matter). All you'll need is the proper cable to connect the monitor to the computer. If necessary, you can make your own cable without too much trouble.

The number of columns displayed on a screen—that is, the number of characters in a horizontal line—is determined by the computer, not by the monitor. A Commodore 64 normally displays 40 columns by 25 lines. It will always display 40 columns by 25 lines, whether it's plugged into an ordinary TV set, a composite color monitor, or an 80-column monochrome monitor. When you see a monitor advertised as an "80-column monitor," it doesn't mean that's all you need to convert your display to 80 columns. It simply means the monitor is capable of clearly resolving 80 columns. You still have to equip your computer with an 80-column video converter or run a special program (such as "Screen 80," COMPUTE!'s GAZETTE, September 1984).

Many people prefer 80-column screens for extended word processing and programming. For one thing, the screen displays twice as much information. And for word processing, an 80-column screen more closely resembles a sheet of paper in a typewriter, making it easier for you to envision how the document will appear when printed out. Some word processing programs have print-preview features which let you view the text on screen exactly as it will be printed on paper, so you can format subheadings, footnotes, running headers and footers, page breaks, outlines, and so on. When formatting isn't too important, 40-column displays can be perfectly adequate.

Unless your computer has a direct-drive video RGB (Red-Green-Blue) output—and Commodore computers do not—you'll most likely need a monochrome monitor to make 80-column displays easily readable without eyestrain. When a 64 is plugged into the rear connections of a Commodore 1701/1702 monitor, 80-column displays are acceptable, but not optimum. There are two ways to improve an 80-column display on a 1701/1702: Use the three rear connectors rather than the two front ones, and unplug the color signal (the one labeled Chroma). For long sessions of programming or word processing, you may want to buy a monochrome monitor as a second display device. Fortunately, prices of these monitors have declined sharply in recent years. They cost about $69 to $150.

Three display colors are available: ordinary black and white, green, and amber. Each has its advocates. Green is the most popular, but amber has gained ground recently. One study indicated that green was preferred for dimly lit rooms (as you might find at home) and amber for brightly lighted offices. Largely, though, it's a matter of personal preference. If possible, try all three before you buy.

The 16 colors on a 64 are a mixture of chrominance (color) and luminance (brightness). There are only four different luminance levels, which means you can choose four shades of green, or amber, for text and background colors.

Some monitors have a 40/80-column switch to adjust the width of the display so characters will appear properly proportioned in either mode. Others have a horizontal-width knob which does the same thing.

Most monochrome monitors have a standard phono jack (RCA jack) for composite video input. Since the Commodore 64 video output is a DIN jack, you'll need a cable to connect the two. The "octopus cable" that comes with Commodore 1702 monitors works fine—plug the luminance output into the monochrome monitor. You can also buy these cables at Commodore dealers and some video supply stores. Some octopus cables have five-pin DIN plugs, while others have eight-pin DINs. Newer Commodore 64s have eight-pin jacks, but the five-pin cables work with both older and newer 64s. If you aren't sure which phono plug on the octopus cable is the luminance output, experiment by plugging them into the monitor input one at a time until a readable display appears (you can't hurt anything by making a mistake).

If you can't find an octopus cable, it's not too hard to make a cable yourself. Five-pin DIN plugs and shielded cables are readily available at electronics parts supply stores such as Radio Shack. Refer to the video output pin map in the *Commodore 64 Programmer's Reference Guide*. Solder one end of the cable to the ground and luminance pins of the DIN plug, and the other end to the ground and positive contacts of the connector which fits your monitor. Be sure not to create a short-circuit by splashing solder across any two contacts, and keep the video cable as short as possible. If you can't solder very well or aren't sure about which pins to hook up, pay a little extra to have the cable made for you by an expert at a computer or video shop.

Q. In the October issue there was again a question regarding which element of a system to turn on first. I have one further question that has not been answered. Is there any problem in having all components hooked up to a power strip and turned on at the same time? I live in an area where power surges and spikes are rare, so a protector is not necessary. So far I have used my Commodore 64, 1541, and monitor in this fashion with no apparent problems.

A. We thought we'd covered all possible bases on this question in the August and October columns, but we forgot about the power strips.

There's usually no problem with turning on a whole computer system in this fashion, even though the sudden draw of current creates a tiny power surge each time you do it. Some electronic devices have built-in buffer circuits to protect their delicate circuitry from power-on surges. When you leave the power switches on and control them from a power strip, you could be negating this feature. But since most home computer systems don't draw much current anyway, the small surge is usually nothing to worry about.

To be absolutely safe, you could separately switch on the device which draws the most power (i.e., the monitor or TV). However, we've never heard of any damage resulting from switching on an entire system with a power strip. If there are any isolated cases to the contrary, we'll be sure to hear about them.

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Michael S. Tomczyk

Beginning Computer Math

Some people think computer math is hard just because it involves numbers. They're wrong. Math is *easier* to understand when you use a computer.

For example, some teachers still think students have to be a certain age to learn algebra—nonsense! Every time you use a variable in a computer program, you're using a type of algebra. If a child can use variables in BASIC programming, then he or she is already applying the principles of algebra.

Common Math Functions	Short Examples to Try
Display numbers	10 A=100: PRINT A: PRINT"ONE HUNDRED="A"."
Counting with FOR/NEXT	10 FOR X=1 TO 100 STEP 2: PRINT X: NEXT
Addition	10 A=3: B=4: PRINT A+B
Subtraction	10 X=255: Y=55: PRINT X-Y
Multiplication	10 N1=10: N2=20: PRINT N1*N2
Division	10 C=100: D=5: PRINT C/D
Fractions	10 PRINT (2/3)*(3/2)
Decimals	10 L=100000: I=.12: PRINT I*L
Negative numbers	10 PRINT .12*100000: PRINT -.12*100000
Exponents	10 PRINT 3↑2
Ratio analysis	10 INPUT"DEBT";D: INPUT"EQUITY";E: PRINT"RATIO="D/E
Formulas	10 INPUT X: DEF FNA(X)=X*.01: PRINT FNA(X)
VAL=string to numeric	10 PRINT"TYPE A NUMBER": INPUT X$: X=VAL(X$): PRINT X
Random Numbers	10 FOR T=1 TO 20: PRINT INT(20*RND(1))+1: NEXT

But why do we say computer math is easy?

BASIC contains a whole set of built-in math functions you can use to solve all sorts of problems, from simple addition to trigonometry. That's what makes computer math so easy. In this lesson, we'll skip the "trig" and focus on the most common BASIC math functions.

Our examples are designed for *non-math* people and you should enjoy them even if you're not a math whiz. All of our programs work with the VIC-20, Commodore 64, Commodore 16, and Plus/4.

Using PRINT To Display Numbers

The first thing you should know is that most calculations work with the PRINT command. Type this line and press the RETURN key:

```
PRINT 1985
```

The computer PRINTs the number on your screen. We can use the PRINT command to calculate, too, like this:

```
PRINT 1985+1
```

When you place a *calculation* or *formula* after the PRINT command, the computer automatically does the calculation and displays the answer (in this case, 1986).

Notice that number values are always PRINTed without quotation marks. Putting the number *outside* quotation marks tells the computer that the number is a value and can be used in calculations.

Putting a number *inside* quotation marks tells the computer that number is part of a message and cannot be used as a value in calculations.

Type these two lines and press RETURN after each line to see the difference (the first use is a *calculation*, the second use is a *message*):

```
PRINT 2+2
PRINT"2+2"
```

If you want to combine a number value or calculation with a word message, the number value or calculation has to go outside quotation marks and the message goes inside quotation marks, like this:

```
PRINT"THIS IS THE YEAR"1985"!"
```

In this example, the entire message goes on the same PRINT line. The *message* begins *inside* quotes, then we put the *number outside* quotes, then we go back *inside* quotes at the end to display the exclamation mark (!). Notice that the computer lets us go in and out of quotes on the same PRINT line.

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The Wizard is a funny old fellow who causes lots of mischief for anyone who enters his cave. He will appear often and ask you to spell a word—you will actually hear the old Wizard's voice!—and you cannot continue your search until you spell the word correctly.

The Wizard will use his magic powers to replenish the energy in your flashlight if you spell the word correctly, but each time you are wrong he will draw energy from your light. When your flashlight runs out of energy you will be doomed to roam through the cave in darkness forever.

During your search you will be confronted with spiders, rocks, snakes, and other dangerous obstacles that will make your quest for freedom even more challenging.

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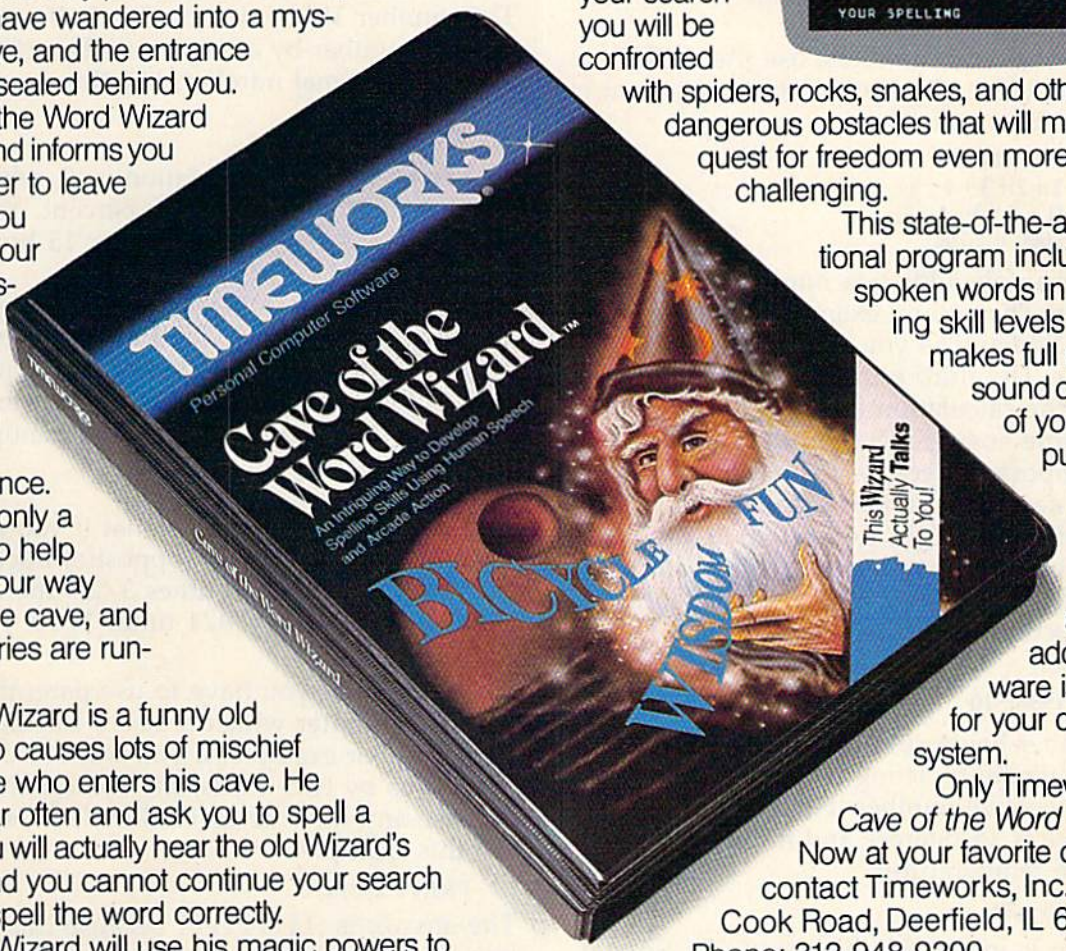
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REM: *You can PRINT numbers, calculations, and answers to math problems directly on your printer instead of the screen. For example, if you wanted to PRINT your number with your printer, you would type:*

```
OPEN 4,4: CMD 4: PRINT 1984: CLOSE 4
```

Using Your Computer As A Simple Calculator

Let's try some calculations. Computer math is the same as the math you learn in school or use at home or in business—with a few small differences that we'll point out as we go along.

To use your computer in *direct* (or *immediate) mode* as a calculator, just type in the calculation you want to print and press RETURN. Presto—your computer automatically gives you the answer. Here's how it works:

To add several numbers, use the PRINT statement followed by the numbers you want to add, as in these examples:

```
PRINT 500+1484
PRINT 1+2+3+4+5
PRINT (1+2+3+4+5)
PRINT 5000+25700
```

The first example adds two numbers and prints the answer. The second example adds several numbers (as many as you want) and also prints the answer. The third example shows that enclosing the calculation in parentheses gives you the same answer. The fourth example is especially important because it shows you that *computers do not use commas in numbers.* In ordinary math, you might type 5,000 or 25,700, but in computer math, you leave out the commas and type 5000 or 25700 without any commas.

Subtraction works just like addition. Here's an example:

```
PRINT 1984-10
```

If the number being subtracted is larger than the number you're subtracting it from, the answer will be a negative number. For example, if the temperature is 15 degrees and it falls 20 degrees, what is the temperature?

```
PRINT 15-20
```

The answer is minus five degrees (−5). So you see, you can have both negative and positive numbers (just like in regular math).

Multiplying numbers on your computer is a little different from multiplying by hand or with a pocket calculator because computers use the asterisk (*) instead of the times sign (×) to multiply numbers. This eliminates confusion between the multiplication sign, the letter X and the X-shaped graphics symbol. Here's an example:

```
PRINT 5*3
```

Let's try a real-life example. What if we wanted to buy a house for $80,000 and the interest rate on the mortgage was 12 percent? How much interest would you pay? The answer is 12 percent times $80,000. To show that on your computer, you'd type the following line:

```
PRINT .12*80000
```

Twelve one-hundredths (.12) is the same as 12 percent so .12 times 80,000 gives us our answer, which is $9,600. Notice we write 80,000 as 80000 and the answer appears as 9600 because the computer doesn't use commas.

Computers use the slash (/) sign instead of the division sign (÷) to divide numbers. The number to the left of the slash is always divided by the number to the right, like this:

```
PRINT 15/3
```

The number 15 divided by 3 is 5. If you divide a smaller number by a larger number, the result will be a decimal number, like this:

```
PRINT 3/15
```

The answer to this calculation is .2, which is the same as 2/10, 20/100 or 20 percent. You can check the answer by multiplying 15 by .2 (the answer should be 3).

The answers to problems involving fractions are always given in decimal form by your computer. For example, the answer to 1 times 1/3 is 1/3, but the computer gives the answer in decimal form as .333333333. Try this example:

```
PRINT 2/3*3/2
```

This example demonstrates that if you multiply a fraction times its *inverse* (opposite) fraction—for example, multiply 2/3 times 3/2—the answer is 1. Try a few others (10/1 times 1/10, 14/7 times 7/14).

Sometimes you have to use parentheses to tell the computer which order to calculate the numbers. For example, if you want to divide two-thirds by two-thirds, the answer should be 1 because any number divided by itself equals 1. Try this example:

```
PRINT 2/3/2/3
```

The answer is .111111111 because this calculation doesn't say divide 2/3 by 2/3. It says divide 2 by 3, then divide the answer by 2, then divide that answer by 3—and the result is .111111111. Try it this way:

```
PRINT (2/3)/(2/3)
```

Now the answer is 1 because we used parentheses to tell the computer that we want it to take the number 2/3 and divide it by (/), the

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number 2/3. If you're ever in doubt as to whether the computer knows which order to calculate, use parentheses to separate the parts of the formula.

The Order Of Calculation

If you have a long calculation involving many different math operations, your computer will always calculate in this order: *exponents first, multiplication and division second, addition and subtraction last.* If there are several math operations in the same category, it will calculate them from *left to right.*

As we've already said, you can make your computer calculate individual operations separately by enclosing them in parentheses. Try these examples (which all give the same answer):

```
PRINT (2↑2)/10+14
PRINT ((2↑2)/10)+14
PRINT (((2↑2)/10)+14)
```

First, the computer performs the exponent operation by taking 2 to the second power—2↑2); second, the computer divides the answer by 10; and last it adds 14.

REM: *Any calculation must contain the same number of left and right parentheses. If you don't "balance" the number of parentheses, you'll get an error when you try to perform the calculation.*

You can change the result of a calculation line by putting parentheses around different parts of the calculation. Try this:

```
PRINT 2↑2/(10+14)
```

Now the computer first takes the exponent of 2 to the power of 2 (which is 4); second, it adds 10+14 (24); and last, it divides 4 by 24.

Calculating With Numeric Variables

If you read our January column, you know we made a New Year's resolution to show you how variables work—so we're putting some special emphasis on numeric variables in our examples (see the reference chart at the beginning of this column).

If I tell the computer the variable A now equals the number 5, the computer now treats the letter A as if it were a 5—as in this example, which defines A as 5 and then prints the value of A:

```
A=5: PRINT A
```

A numeric variable can be a letter like A, two letters (like AB), or a letter and a number (like A2). Numeric variables are used to stand for numbers and can be used in many creative ways.

Using a variable to stand for a number lets you use that number over and over again in various calculations.

If we define the variable A as the number 5, the computer will display the number 5 (the value of the variable) when we print A. You can also include variables in calculations and formulas, like this:

```
A=5: PRINT A: PRINT A+1: PRINT A+2
```

In this example, we define the variable A as 5, then we print A, which is the same as saying print 5. Next, we add 1 to the value of A and print the result, which is 6, then we add 2 to the value of A and print the result, which is 8.

Some Practical Examples

Let's try some simple math problems. For example, how could we figure out what price we can pay for a new home? One way is to see how much the interest payments would be if we took out a mortgage. Our bank will give us a mortgage at 12 percent interest, so let's calculate how much interest we have to pay for houses costing between $50,000 and $120,000—in $10,000 increments. This may sound a little complicated, but we can do the whole calculation in two program lines, like this:

```
10 FOR X=50000 TO 120000 STEP 10000
20 PRINT"INTEREST="X*.12"ON HOUSE
   COSTING"X: NEXT
```

Type RUN and press RETURN. Impressed? Computers can make math calculations very powerful, and fast, too. The first part of the FOR-NEXT loop tells the computer we're going to define X as a range of numbers from 50,000 to 120,000. STEP 10000 tells the computer to "step" through the range at intervals of 10,000 at a time. Line 20 displays the INTEREST= part of the message. Then we go outside quotation marks to multiply our first house price ($50,000) times our interest rate (.12), which prints the answer. Then we print the rest of our message "ON HOUSE COSTING" and the X which at this point is 50000. The NEXT command tells the computer to go back and do it all over again—except this time X will be 60,000—then 70,000 and so on up to 120,000 where the program automatically stops because 120,000 is the top of the range defined by the TO part of the loop. You might note that we're using a 12% annual interest rate; if you were really planning to buy a house, you'd have to factor in periodic payments and the effects of compounding the interest.

Here's another practical example:

```
10 PRINT"ENTER A SAVINGS AMOUNT": INPUT S1
20 PRINT"ENTER AN INTEREST RATE": INPUT R1
30 PRINT"FIRST YEAR INTEREST IS:" S1*R1
```

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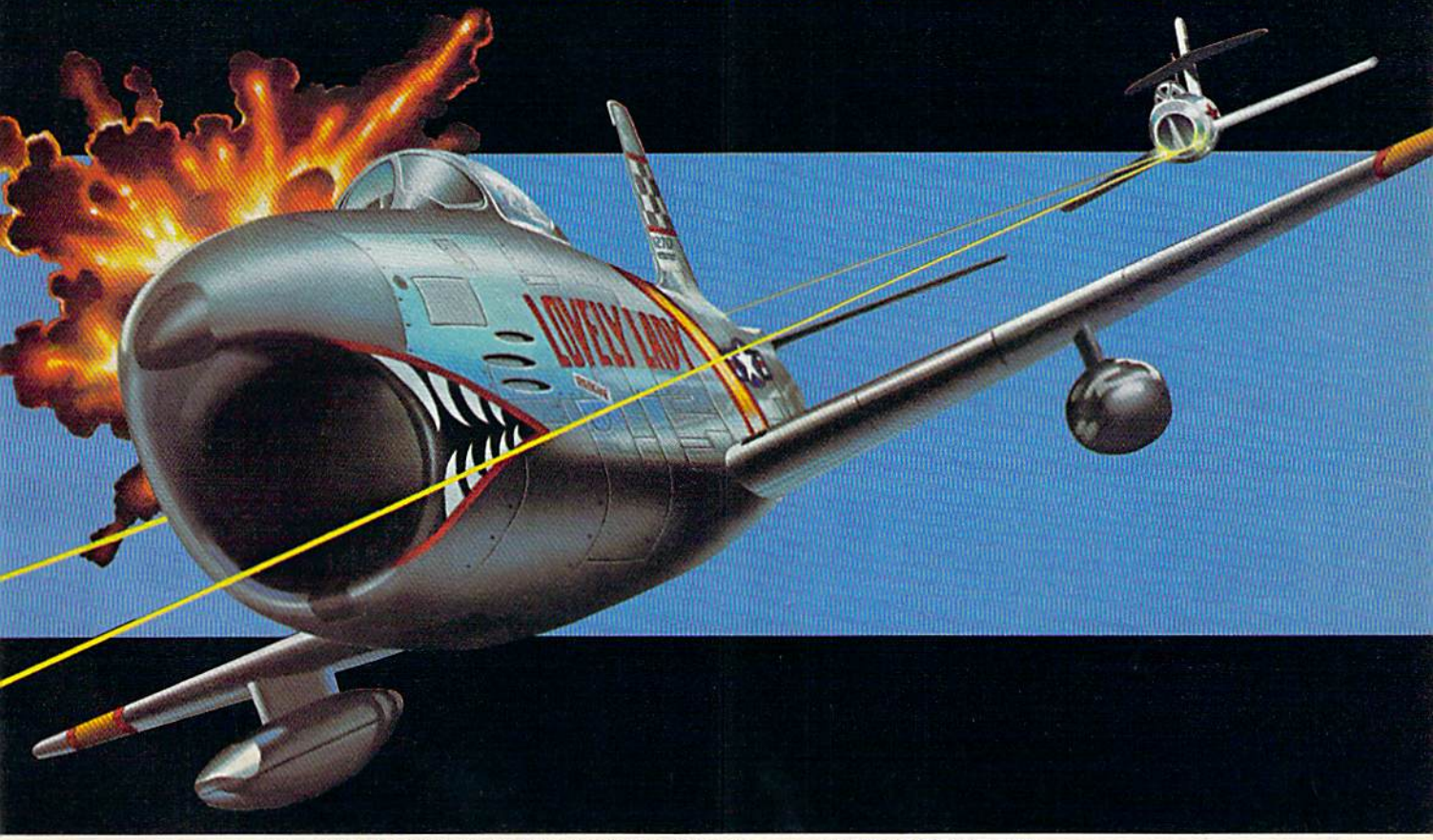

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```
40 PRINT"TOTAL AFTER FIRST YEAR INCLUDING
   INTEREST IS:"S1+(S1*R1)
```

Line 10 prints the opening prompt message, followed by an INPUT statement which defines the number typed in as variable S1.

Line 20 prints another prompt message with an INPUT whose variable is defined as R1.

Line 30 prints a message followed by the first year's interest earned—the result of multiplying the variable S1 (savings amount) times R1 (interest rate).

Line 40 prints another message followed by a calculation which shows the total savings plus interest earned (the total amount you have after adding the interest you earned). This time the result is obtained by adding the savings amount to the interest earned (note the result of the calculation is automatically printed because it's still part of the PRINT statement).

The examples we've seen here have hundreds of variations. They're just a beginning. You can perform all sorts of calculations for use in school, at home, or in business. Try it. You'll find it's easier than you thought.

Next month we'll continue with our discussion of computer math and include some advanced computer math techniques for beginners.

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By Elliot B. Schneider

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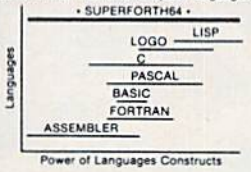

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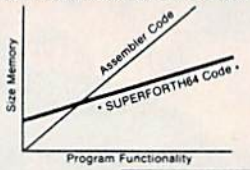

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The Forbidden Crypt

Ted Reynolds

You're a leading archaeologist who's happened on a fabulous treasure. But spiders, bats, snakes, and ghouls guard the riches. How long can you survive in the forbidden crypt? An action game for the VIC, 64, Plus/4, and 16. A joystick is required.

A local legend, long dismissed as mere myth, speaks of a great and powerful king who once ruled this area. While investigating the origins of this tale, you've discovered a cenotaph covered with unusual glyphs. They're difficult to translate, but seem to say something about the king and guardians and forbidden treasure. Undaunted, you open the door and enter. The door slams shut, leaving you stranded in the crypt.

Survival in "The Forbidden Crypt" is not easy. Each level contains four rooms into which you must enter and retrieve a treasure. That's easy enough, but avoiding the spiders, bats, snakes, and ghouls—guardians of the treasure—is not. And the only way to get to the next level is to claim the treasure from all four rooms.

Thrown Into Action

Game play begins with an overview of the four rooms, each with two doors, one on the left and one on the right. Below the playing screen is Score, Level, and Lives. You're represented by the red dot on the screen, and you can begin in any room at any door. Using a joystick (port 2 on the 64, port 1 on the Plus/4 and 16), move into a room (hint: You'll have more success if you enter from the door on the right), and you're immediately thrown into the action. The screen changes to a full view of the room you've entered.

The treasure is often difficult to get to as the guardians, four per room, pursue you. Their touch is deadly. You can defend yourself by aiming the joystick at a guardian and pressing the fire button. A hit eliminates a guardian. In the 64 version, you have only three shots per room *and* the guardians move faster towards you after one of their companions has been eliminated.

After grabbing the treasure and avoiding the guardians, head for the exit. You must leave the door opposite the one you came in (either door in the VIC version). If you make it, you'll be back to the four-room overview, and the room you've just left will contain a mark to indicate that you've completed it. Sometimes, you'll be doing well just to escape the room, even without the treasure. In this case, you'll have to return to the room and try again. Remember, you can't get to the next level until you've found a treasure in each of the four rooms.

Extra Lives

In the VIC version, you begin with ten lives, and you cannot earn bonus lives. In the other versions, you begin with five lives, but get an extra one for every four levels completed. Also, in the 64, Plus/4, and 16 versions, the guardians speed up after an extra life is awarded, so the game becomes increasingly difficult.

The Forbidden Crypt is not an easy game beyond the first few rounds. Success will come with some practice and devising a good strategy.

Special Instructions For The VIC Version

The VIC version requires at least 8K expansion memory (16K or 24K will also work). There are three programs in all. Program 1 changes some

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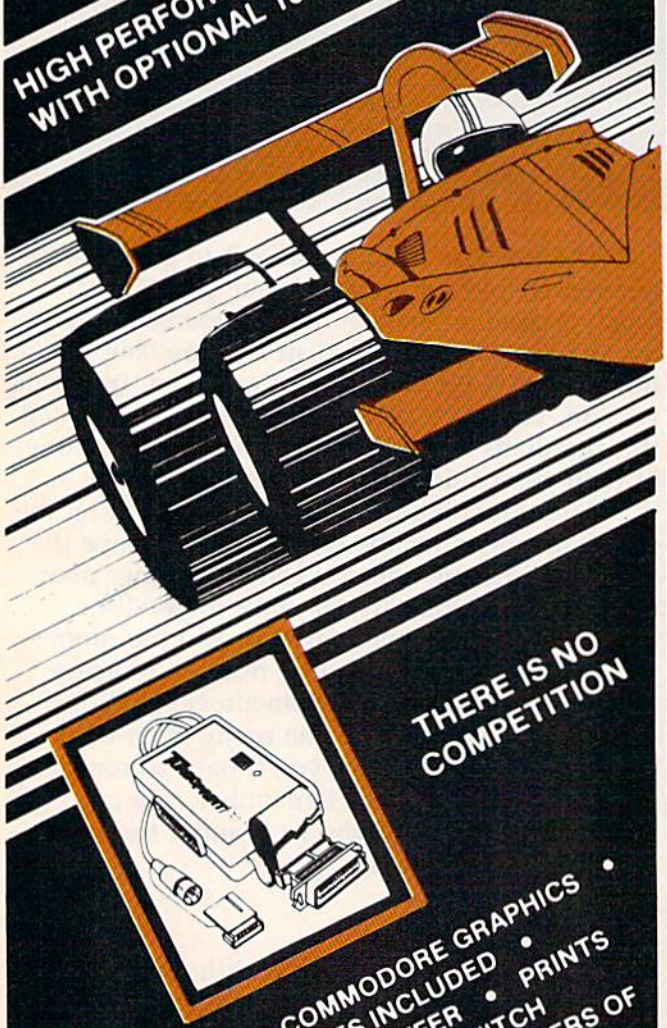

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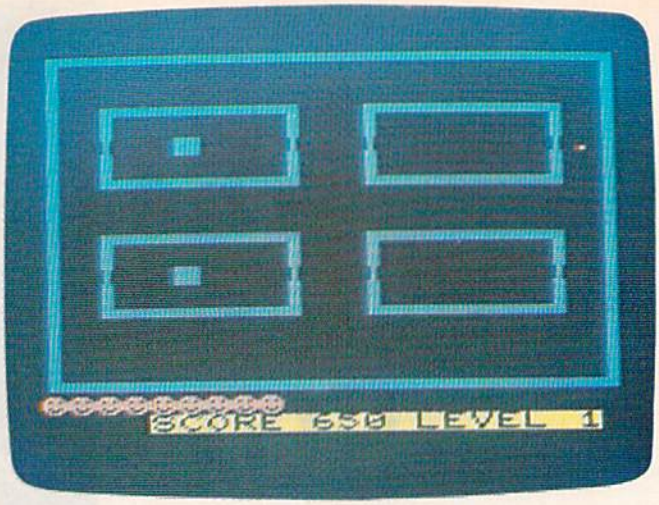


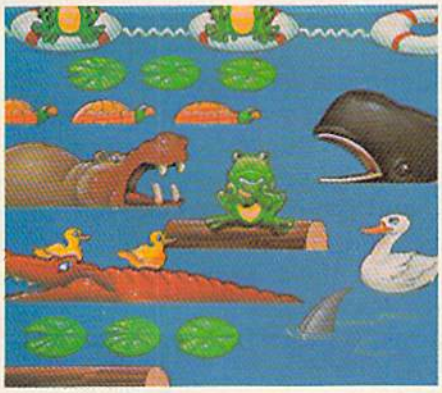
The player has completed two rooms and is about to enter the one at the upper right (VIC version).

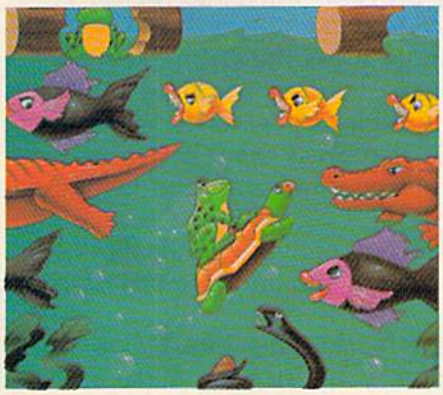
memory pointers to protect the memory used for redefined characters. In line 130 of Program 1, the line under the O means you should hold down the SHIFT key when you type the O (L SHIFT-O is the abbreviation for LOAD). Tape users should change the 8 in that line to a 1, as noted in the REMark in line 140. After typing Program 1, save it to tape or disk (do not run it yet). Then type in Program 2 and save it with the name "A" (so it will load properly). Tape users must change line 150 as noted in line 160. Type NEW, and enter the main program (Program 3), which must be saved with a filename of "B". Load and run the first program, which loads Program 2 (A). Program 2 redefines the characters and loads Program 3.

See program listings on page 132.

Four approaching ghouls stand between the player and the treasure (64 version).

SO YOU THINK YOU GOT THE BEST OF FROGGER AND ZAXXON? SORRY.





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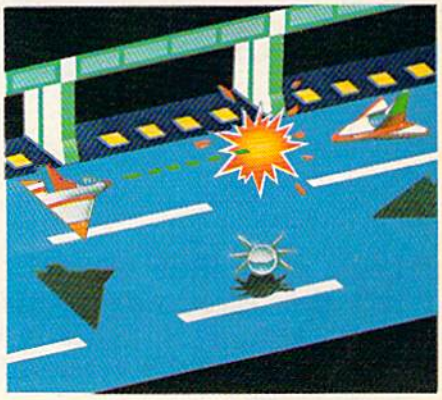
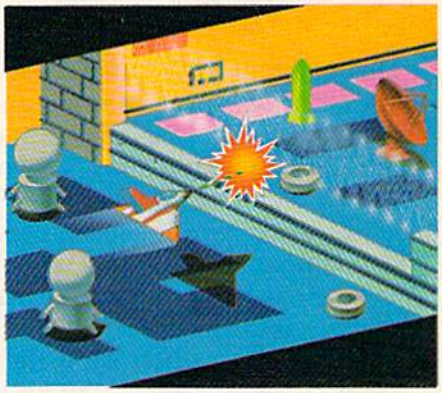
✓NEW	✓NEW	✓NEW	✓NEW	✓NEW	✓NEW	✓NEW	✓NEW	✓NEW	FROGGER II
		✓NEW	✓NEW	✓NEW	✓NEW		✓NEW	✓NEW	SUPER ZAXXON





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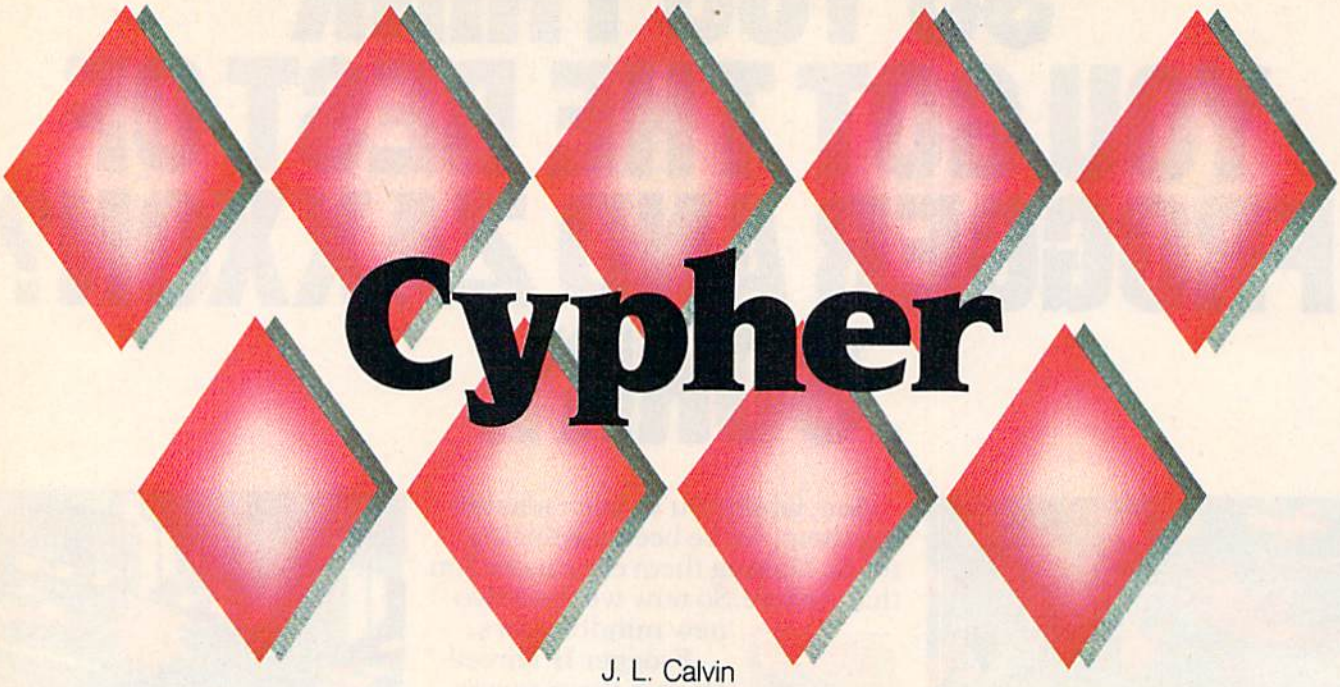
INTRODUCING FROGGER II THREEEDEEP AND SUPER ZAXXON.



J. L. Calvin

Logic and a little luck will help you unlock the secret code in this game of deductive reasoning. Originally written for the 64, we've added a version for the VIC.

This game of logic is based on the popular game *Master Mind*. After entering and saving the program, type RUN, and you'll be given the option of receiving instructions. When the game begins, six red diamonds appear in the top left-hand corner of the screen. Beneath these diamonds is a six-element color code. The object of the game is to figure out and duplicate this code in the least number of turns.

Enter your guess by using the color keys located at the top left of the keyboard. As each key is pressed, the color you've chosen appears on the screen, accompanied by a musical tone (the sequence of the eight colors plays a scale). After six keys have been pressed, the computer compares your guesses with the code hidden beneath the diamonds. Your score is then displayed to the right of your guess. The secret code can duplicate colors. For example, the code may contain two blues or three purples.

Scoring

There are three symbols used in scoring each round. (These are also explained in the screen instructions.)

A plus sign (+) indicates that one of the guessed colors is correct and in the right location (but this doesn't necessarily correspond to the location of the scoring marker).

A zero (0) means that one of the colors is correct, but its location is wrong.

An at sign (@) indicates that a color is not in the secret code.

For example, suppose a score reads ++00@@. This means that two of your guesses are the correct color and in the correct location, two of your guesses are the correct color but in the wrong location, and the other two guesses do not exist in the secret code. *Be sure to understand that the scoring marker locations do not correspond to the guess locations.*

You have 12 turns to determine the correct color combination. As you proceed, carefully study the scores of previous moves to logically deduce the secret code.

If you accidentally press the wrong key while entering a guess, you can use the DELete key. This erases all previous guesses in the current move. You can also press the 9 key to instantly see the secret code and end (and lose) the game.

A score of nine or ten is very good, six, seven, or eight is exceptional, and five or less is just plain lucky.

If you're using a black-and-white TV or monochrome monitor, you'll need to make a few modifications so you can easily distinguish between colors. If you're using a 64, make the following changes in Program 1:

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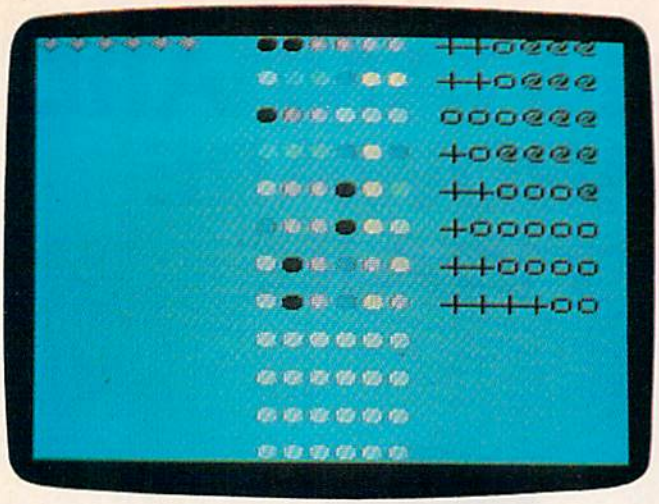
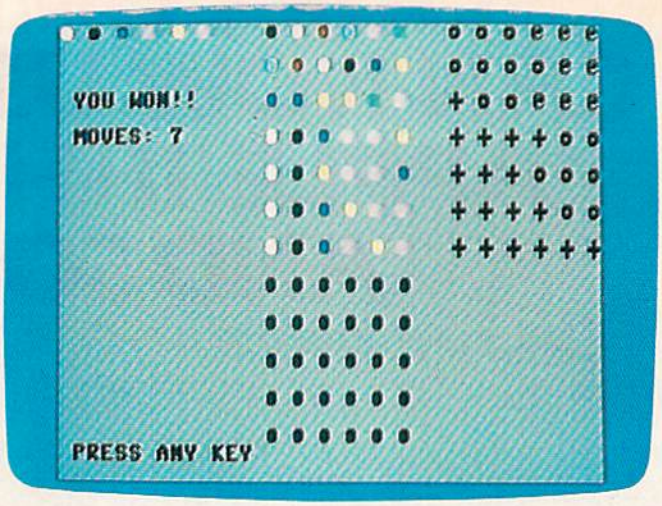


One step away from victory in the VIC version.



Winning requires a combination of logic and lucky guesses (64 version).

```
410 POKEGLOC,Z(I)+49                    :rem 161
430 GLOC=GLOC+2                         :rem 123
670 GLOC=GLOC+68                        :rem 189
810 POKEANS,A(T)+49                      :rem 84
820 POKECANS,0                           :rem 74
1020 FORDE=I*2TO1STEP-1:POKEGLOC-DE,32:GO
     SUB1510:NEXTDE                     :rem 219
1040 GLOC=GLOC-(I*2)                    :rem 111
```

For the VIC, make these changes in Program 2:

```
410 POKEGLOC,Z%(I)+49:GOSUB1330:GLOC=GLOC
    +1:NEXT:FORI=0TO7                   :rem 142
670 GLOC=GLOC+38                        :rem 186
810 POKEANS,A%(T)+49                    :rem 121
820 POKECANS,0                           :rem 74
1020 FORDE=ITO1STEP-1:POKEGLOC-DE,32:GOSU
     B1510:NEXTDE                       :rem 127
1040 GLOC=GLOC-(I*1)                    :rem 110
```

See program listings on page 129.

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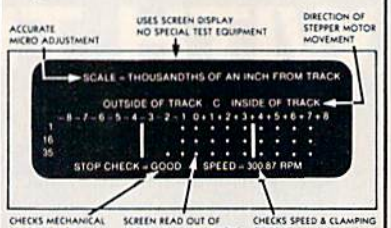
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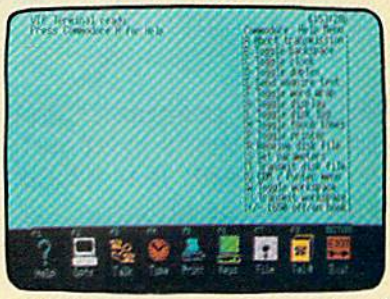

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Help is built right into the program so you can't get lost or confused. The manual is even capsulized on the disk for reference from the program when you need it. VIP Terminal also has a chiming clock for the quarter hour and the hour, and an alarm you can set. There's even a musical alarm to let you know when you have a call. VIP Terminal has put it all together to make the perfect communication program!

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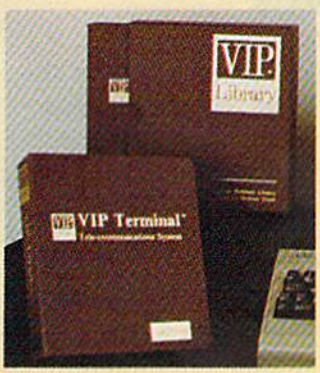

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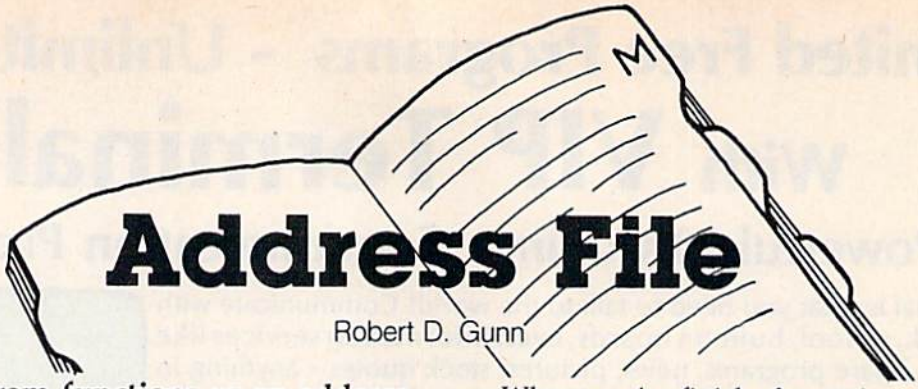


Address File

Robert D. Gunn

This short program functions as an address data base that's extremely easy to use and very efficient. It works on the VIC or 64 with disk or tape.

If you collect slips of paper with addresses and phone numbers, or if you have an address book that gets more and more cluttered as you update addresses and scratch out old ones, it's time for a change. "Address File" provides instant access to names, addresses, and phone numbers. It offers some special features, such as an alphabetical sort and an instant find after you type in a person's last name.

Adding to or editing the file is simple. The entire program is operated from a menu, and responding to prompts is all that's needed.

It runs on a VIC (with or without expansion) or a 64, and automatically sets up the file on disk or tape. Just respond to the DISK OR CASSETTE? prompt when saving or retrieving a file.

Simple Choices

After entering and saving the program, type RUN. The main menu appears:

1. RETRIEVE FILE
2. ADD/START FILE
3. EDIT FILE
4. DISPLAY FILE
5. SAVE AND END

To create the address file, choose option 2. A record number (#1 if you're starting a new file) appears at the top of the screen. You're then prompted for last name, first name, address, city/state (be sure to use the slash to separate the two), zip code, and telephone. The program gets information from INPUT statements, so avoid using commas in records. If you choose not to enter data in a field (for example, you don't have a phone number for a person), enter NONE. After entering each item, press RETURN. At the end of each record, you're then given a choice of Next (to continue entering data), Delete (to redo the record just entered), or End (to take you back to the menu).

When you're finished entering data, choose option 5 to save the file. Answer the DISK OR CASSETTE? prompt by pressing D or C, and the file is saved. Tape users should use a new cassette rewound to the beginning and keep this tape reserved only for this file. Disk users may wish to use a fresh disk reserved for this file only, especially if a growing file is anticipated.

After the file is created and saved, the next time the program is run, you'll want to select option 1 (be sure the right tape or disk is inserted). To continue adding to the file, choose option 2. A new record number will appear, continuing from the end of the existing file. (For example, if you made five entries, saved the file, then reloaded it, you'd see Record #6 when resuming.) If you wish to edit the file (for example, change an address or phone number), select option 3. You're then asked to enter a last name. All the current information for that individual is displayed and you're then given a choice:

1. LAST NAME
2. FIRST NAME
3. ADDRESS
4. CITY/STATE
5. ZIP CODE
6. TELEPHONE
7. DELETE ENTRY

Select any of the first six and the current information for that field is displayed along with a prompt for new data. Choose option 7 to delete a record.

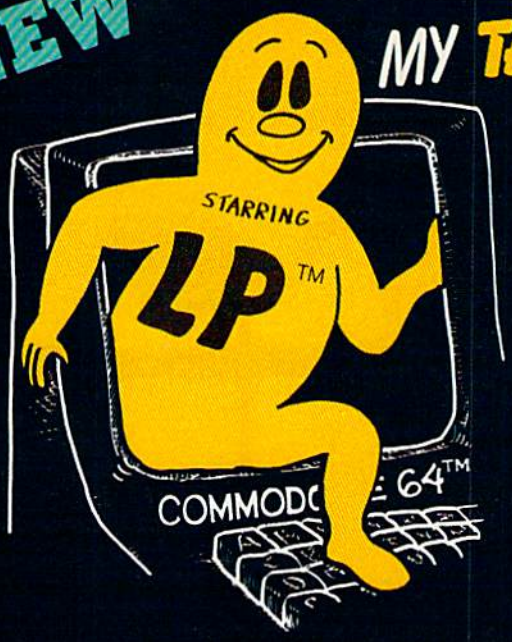
Option 4, Display File, calls another screen from which you choose to see an alphabetical list of all names, an individual name (enter a last name), or return to the menu.

Number Of Records

The program is written to accommodate 12 records on the unexpanded VIC and 200 on the 64. To increase the number of records, change the value of L in line 10. VIC users must use expansion memory to have more than 12 records. Commodore 64 users should note that only the second L value (at the end of line 10) need be changed if any increase in record number is desired.

See program listing on page 139.

NEW



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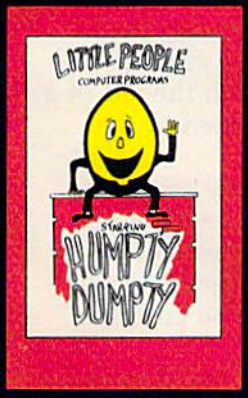

Humpty Dumpty
Alphabet program
by Dave Paulsen
Put Humpty together again and learn: the Alphabet, the Computer Keyboard, how to spell your Name . . . and more.

Little Bo Peep
Number program by
Joe Sams and
Scott Barker
Bring Bo-Peep's sheep home and learn: to Count, to spell your Name, the Computer Keyboard . . . and more.

L. P. Money I
by Aaron Grant
Teaches money values — one cent to one dollar — using a gum ball machine. Encourages money saving.

L.P. Money II
by Tom Wanne
Teaches money values — one dollar to one hundred dollars — using an ice cream machine. Encourages money saving.

L. P. Shapes
by Doug Knapp
Learn to recognize geometric shapes and how to spell their names.

L. P. Traffic Signs
by Tom Wanne
Teaches identification and meanings of traffic signs and signals. Increases safety awareness.

L.P. Child Protection
by Tom Wanne
Teaches children how to protect themselves against the possibility of being kidnapped. Excellent graphics.

L. P. Colors
by Aaron Grant
Teaches names and identification of colors and reinforces learning of colors and shapes.

L. P.'s Farm
by Aaron Grant
Teaches names and identification of farm animals.

L.P. Addition
by Doug Knapp
Teaches addition using numeric figures and objects. Nine levels of difficulty. Great introduction to math.

L.P. Subtraction
by Doug Knapp
Teaches subtraction using numeric figures and objects. Nine levels of difficulty. Great introduction to math.

L.P. Opposites
by Tom Wanne
Teaches opposites such as large, small; tall, short. Multiple choice quiz. Excellent graphics.

L.P. Multiplication
by Aaron Grant
Teaches multiplication using numeric figures and charts. Varying levels of difficulty.

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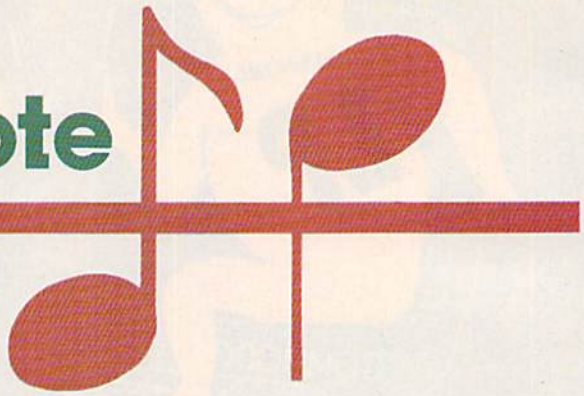

Carlos Esteves

Learning the names of the notes of the treble and bass clefs is one of the more tedious exercises for beginning music students. Why not let your computer help? Originally written for the unexpanded VIC, we've added versions for the 64, the Plus/4, and the 16.

The first stumbling block on the way to proficiency in reading music is learning the positions of notes in the treble and bass clefs. "Name That Note" is a teaching aid, designed to help the beginning music student develop instant recognition of notes. After entering the program, save a copy to tape or disk. Type RUN, and you'll soon see a prompt, asking you to choose treble, bass, or both. If you're just starting out, selecting the treble clef is the best choice. When this one is mastered, practice with the bass clef, then combine the two.

Program Feedback

After selecting one or both clefs, a randomly generated note appears on the staff. The counter at the upper-left corner of the screen begins counting down from nine seconds. If you don't name the note by pressing the appropriate letter on the keyboard within this time limit, another note is chosen and the counter starts over. Another category, Misses (upper right of the screen), includes both wrong guesses and no guesses within the nine-second time limit.

A correct answer is rewarded by the playing of the note and a number of points added to Score (top center of screen). Promptness in answering means a better score, but errors get no points at all. At the end of a round of 20 notes, the final score and number of misses is displayed with an option to play another round. Progress can easily be monitored by jotting down scores and comparing them.

The Plus/4 And 16 Version

Because sound is handled the same way in the Plus/4 and the 16, Program 3 works for either machine. As in the VIC and 64 versions, redefined characters are required. The custom character set is located at 15360 with the aid of a short machine language routine placed in the cassette buffer at 819.

When you run the program, any errors which occur after the characters have been redefined will cause random garbage to appear on the screen. This is because the character-set pointers have been set to point at the custom characters.

At this point, there are several ways to retrieve your program (restore the character set pointers) and determine the cause of an error. One way is to press the RESET switch while holding down the RUN/STOP key. *(Note: Be careful when doing this since RESET alone performs a cold start of the computer and thus erases any program from memory.)* This operation puts you in the built-in monitor. Press X to exit BASIC. Then press the HELP key, and the statement where the error occurred will be printed (flashing) on the screen.

An easier way to recover from this situation is with the aid of a user-defined function key. Before you enter the program, define a function key so that when you press it, the character set pointers will position to their normal place.

A Printer For All Reasons

Search For The Best High Quality Graphic Printer

If you have been looking very long, you have probably discovered that there are just too many claims and counter claims in the printer market today. There are printers that have some of the features you want, but do not have others. Some features you probably don't care about, others are vitally important to you. We understand. In fact, not long ago, we were in the same position. Deluged by claims and counter claims. Overburdened by rows and rows of specifications, we decided to separate all the facts — prove or disprove all the claims to our own satisfaction. So we bought printers. We bought samples of all major brands and tested them.

Our Objective Was Simple

We wanted to find that printer which had all the features you could want and yet be sold directly to you at the lowest price. We wanted to give our customers the best printer on the market today at a bargain price.

The Results Are In

The search is over. We have reduced the field to a single printer that meets all our goals (and more). The printer is the GP-550CD from Seikosha, a division of Seiko (manufacturers of everything from wrist watches to space hardware). We ran this printer through our battery of tests and it came out shining. This printer *can* do it all. Standard draft printing up to a respectable (and honest) 86 characters per second, and with a very readable 9 (horizontal) by 8 (vertical) character matrix. At this rate, you will get an average 30 line letter printed in only 28 seconds.

"NLQ" Mode

One of our highest concerns was about print quality and readability. The GP-550CD has a print mode termed Near Letter Quality printing (NLQ mode). This is where the GP-550CD outshines all the competition. Hands down! The character matrix in NLQ mode is a very dense 9 (horizontal) by 16 (vertical). This equates to 14,400 addressable dots per square inch. Now we're talking ***quality*** printing. You can even do graphics in the high resolution mode. The results are the best we've ever seen. The only other printers currently available having resolution this high go for $500 and more *without* the interface or cable needed to hook up to your Commodore!

Features That Won't Quit

With the GP-550CD your computer can now print 40, 48, 68, 80, 96, or 136 characters per line. You can print in ANY of 18 font styles. You not only have the standard Pica, Elite, Condensed and Italics, but also true Superscripts and Subscripts. Never again will you have to worry about how to print H_2O or X^2. This fantastic machine will do it automatically, through easy software commands right from your keyboard. All fonts have true descenders.

One of the fonts we like best is "Proportional" because it looks most like typesetting. The spacing for thin characters like "i" and "l" are given less space which "tightens" the word making reading easier and faster. This is only one example of the careful planning put into the GP-550CD.

Do you sometimes want to emphasize a word? It's easy, just use **bold** (double strike) to make the words stand out. Or, if you wish to be even more emphatic, underline the words. Or do both. You may also wish to "headline" a title. Each basic font has a corresponding elongated (double-wide) version. You can combine any of these modes to make the variation almost endless. Do you want to express something that you can't do with words? Use graphics with your text — even on the same line.

You can now do virtually any line spacing you want. You may select 6, 8, 7½ or 12 lines per inch. PLUS you have variable line spacing of 1.2 lines per inch to infinity (no space at all) and ***97*** other software selectable settings in between. You control line spacing on a dot-by-dot basis. If you've ever had a letter or other document that was just a few lines too long to fit a page, you can see how handy this feature is. Simply reduce the line spacing slightly and . . . VOILA! The letter now fits on one page.

Forms? Yes! Your Letterhead? Of Course!

Do you print forms? No problem. This unit will do them all. Any form up to 10 inches wide. The tractors are adjustable from 4½ to 10 inches. Yes, you can also use single sheets. Plain typing paper, your letterhead, short memo forms, anything you choose. Any size under 10" in width. Multiple copies? **Absolutely!** Put forms or individual sheets with carbons (up to 3 deep), and the last copy will be as readable as the first. Spread sheets with many columns? **Of course!** Just go to condensed mode printing and print a full 136 columns wide. Forget expensive wide-carriage printers and changing to wide carriage paper. You can now do it all on a standard 8½" page.

Consistent Print Quality

Most printers have a continuous loop ribbon cartridge or a single spool ribbon which gives nice dark printing when new, but quickly starts to fade after a while. To keep the printers' output looking consistently dark, the ribbons must be changed more often than is healthy for the pocketbook. The GP-550CD solves this problem completely by using a replaceable, inexpensive ink cassette which is separately replaceable from the actual ribbon. It keeps the ribbon loaded with ink at all times. You only replace the ribbon when it truly wears out, not when it starts to run low on ink. Just another example of the superb engineering applied to the GP-550CD. (When you finally do wear out your ribbon, replacement cost is only $10.95. Ink cassette replacement cost is only $5.95, both postpaid.)

The Best Part

When shopping for a quality printer with all these features, you could expect to pay around $500 or more. *Not any more!* We have done our homework. You don't have to worry about interfaces or cables. Everything is included. We are now able to sell this fantastic printer for **only $259.95!** The GP-550CD is built especially for the Commodore 64, VIC-20, Plus 4 and C-16. All Commodore graphics are included. This printer does everything the Commodore printers do but has more features. **You need absolutely nothing else to start printing–just add paper.** We also have specific models for other computers. Call for details.

No Risk Offer

We give you a 15-day satisfaction guarantee. If you are not completely satisfied for any reason we will refund the full purchase price. A 1-year warranty is included with your printer. The warranty repair policy is to repair or replace and reship to the buyer within 72 hours.

The Bottom Dollar

The GP-550CD is only $259.95. Shipping and insurance is $8.00 — UPS within the continental USA. If you are in a hurry, UPS Blue (second day air) is $18.00. Canada, Alaska, Mexico are $25.00 (air). Other foreign is $60.00 (air). California residents add 6% tax. These are cash prices — VISA and MC add 3% to total. We ship the next business day on money orders, cashiers' checks, and charge cards. A 14-day clearing period is required for checks.

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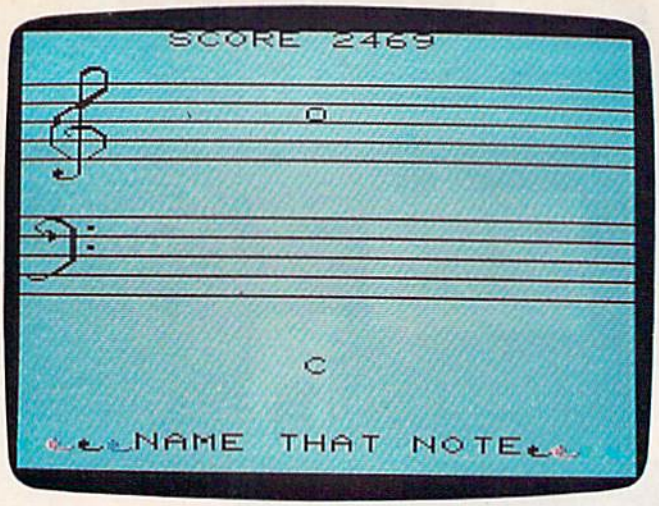

A correct answer (C) has added to the player's score.

Here's the line you need to enter in immediate mode to redefine the f1 key for our purposes:

KEY1, "POKE65298,196:POKE65299,208:"+CHR$(13)

(Note: Since notes below the low A on the bass clef are not available on the Plus/4 and 16, the program will not select these notes.)

See program listings on page 142.

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VIC Quiz Generator

George Trepal

The VIC can be a valuable educational tool for parents and teachers. Here's a short program that sets up and manages a quiz for almost anything you wish to teach. Simple instructions are included for those with expansion memory who wish to add more questions and answers.

If you're a parent or teacher, "VIC Quiz Generator" can help you in teaching nearly any subject. The program asks questions, which the student then answers. You can opt for the order of questions to be generated randomly, so the student will have to learn the material rather than memorizing a sequence.

Questions are displayed one at a time, and the student's answer is then compared to the answer in the DATA statements, beginning at line 1000. If the answer is correct, the computer makes a note not to ask the question again. If an incorrect answer is given, the correct answer is shown, and the computer remembers to ask that question later in the quiz. After a second incorrect answer, points are deducted from the final score. No question is asked more than two times in the same quiz.

At the end of each quiz, a final score is given—a standard percentage score, 90% for nine of ten answered correctly, for example—and the student has the option to retake the quiz.

Modifying Quiz Data

The program includes six sample questions and answers found in DATA statements 1000–1050. Also, note line 140, which defines S$ as "WHO WROTE". The procedure for replacing these questions and answers and adding more is simple. After deciding what kind of quiz and data you wish to insert, LIST the program and replace the DATA beginning at line 1000 with your own. Note that each question must be preceded by a pound sign (#) and each answer with an asterisk (*). Be sure to put the question and answer on the same line in the DATA statement (see line 1000 for an example of how this is done).

To add more questions, simply continue adding DATA statements, but *be sure the last line of the program is DATA 999.* This acts as a "flag" to tell the program that it's read *all* the data you've entered. Notice that line 1060 contains this flag. If you've created twenty DATA statements (questions and answers) and incremented the line numbers by ten, your DATA statements should run from 1000–1200 with the final line being 1200 DATA 999.

Whether or not you're using memory expansion, you'll have to make sure that your growing program fits into memory. After adding a number of DATA statements, press RUN/STOP–RESTORE, then type PRINT FRE(0) to see how many bytes remain. Any memory expansion will allow for a large quiz.

One other line you may have to change when modifying the program is line 140. If you're not creating a quiz about authors, you'll have to change S$ to "WHO COMPOSED", "WHAT IS", or whatever phrase you need to make the question appropriate.

An interesting technique used by the program is found in lines 110 and 120. The variable N is defined by the number of DATA statements read in line 110. So the program DIMensions the number of questions and answers according to the number of DATA statements it counts. When 999 is read, N is set throughout the program.

See program listing on page 145.

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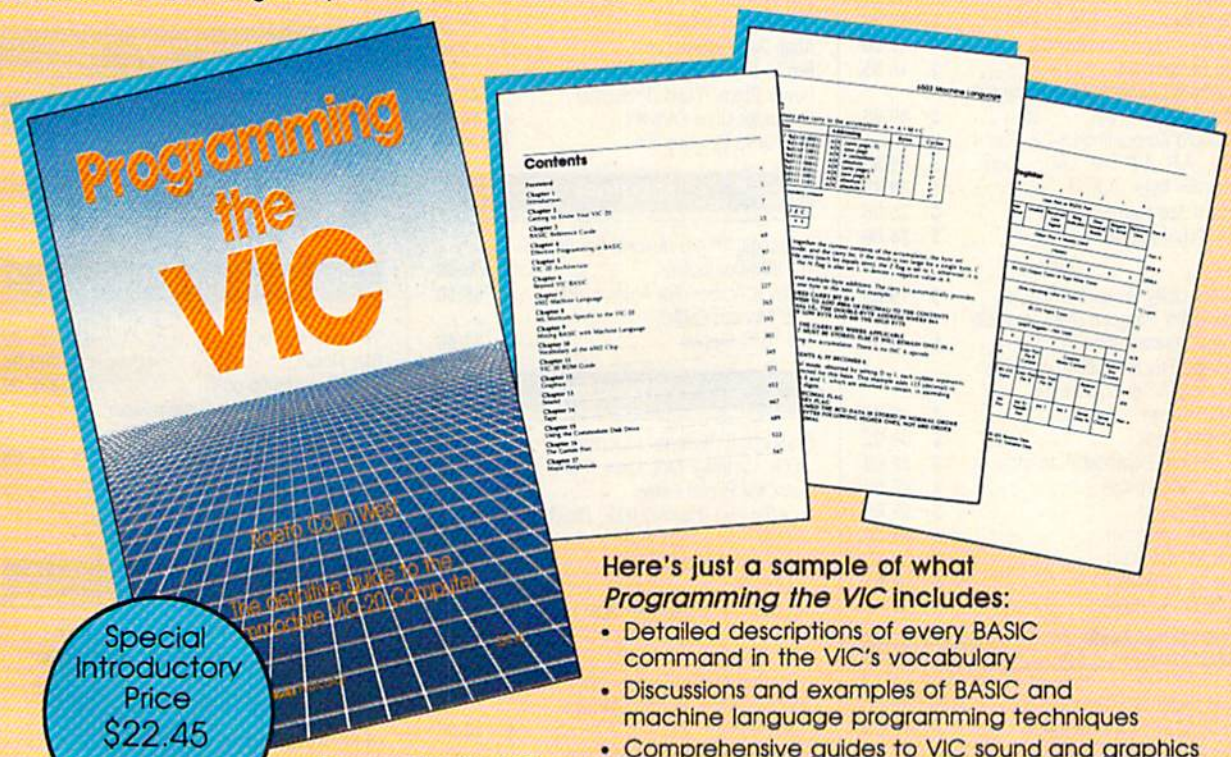

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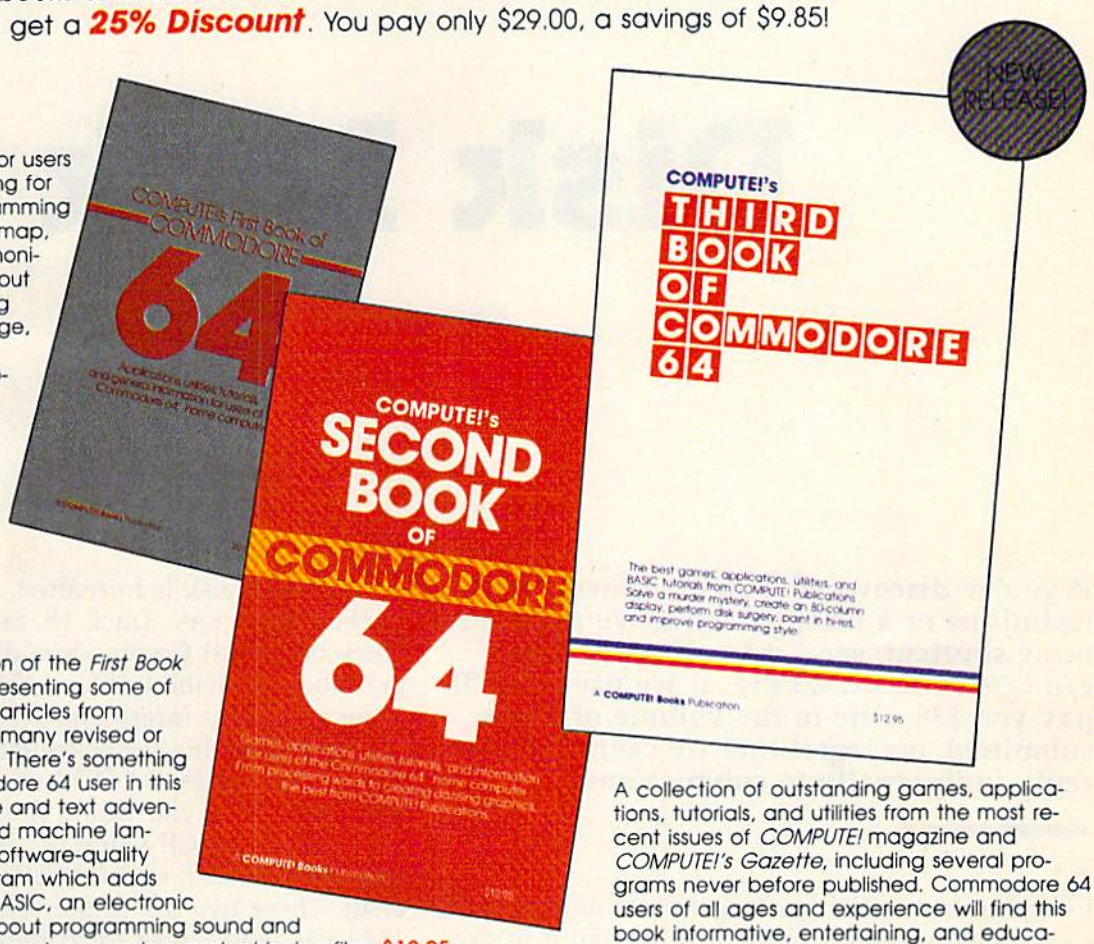
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Disk Lock

Kevin Hawkins

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Everyone knows that putting a piece of tape over a disk's write-protect notch will prevent it from being written to by the disk drive. You can load programs but not save, read files but not write to them.

The tab is easily removed by any user (which defeats the purpose of write-protection). And improperly positioned tape can be an annoying hindrance when inserting or removing disks. If the tape is loose, you may have to reach in with your fingers and pull the disk out.

In some applications, particularly those involving children, you may want to add an extra measure of protection.

Compatibility And DOS Flags

The Disk Operating System (DOS) of the 1541 is a descendant of operating systems from previous Commodore disk drives. Commodore has managed to keep a good deal of compatibility between the different drives.

When a disk is formatted, it's organized into tracks and sectors. Track 18, Sector 0 is a control block on (most) Commodore disks. It contains the Block Availability Map, disk name, ID, and other important information.

Byte 2 of this sector contains a flag that indicates the version of DOS used to format the disk. Normally, you would find a value of $41 (decimal 65, ASCII value of "A") here. This signals that the disk was formatted on a 1541 or a 4040. These two drives are format-compatible. A 1541 can read a disk formatted on the 4040, and vice versa. Theoretically, you can also write to a 4040 disk, although in practice it won't always work perfectly (because the 1541 is slower and may be aligned a little differently).

There was once a Commodore drive called the 2040 which put a few extra sectors on each disk. The DOS version flag at track 18, sector 0, byte 2 contains a $01 if the disk was formatted on a 2040.

Disks from a 2040 are read- but not write-compatible with the 1541 format. You'll get an error 73 if you try to save a program or write to a 2040 disk from a 1541. The red light will start blinking because the 1541 refuses to write to a 2040-type disk.

Software Write Protection

If we change this flag byte on the disk, we can fool the disk drive into thinking we are using a

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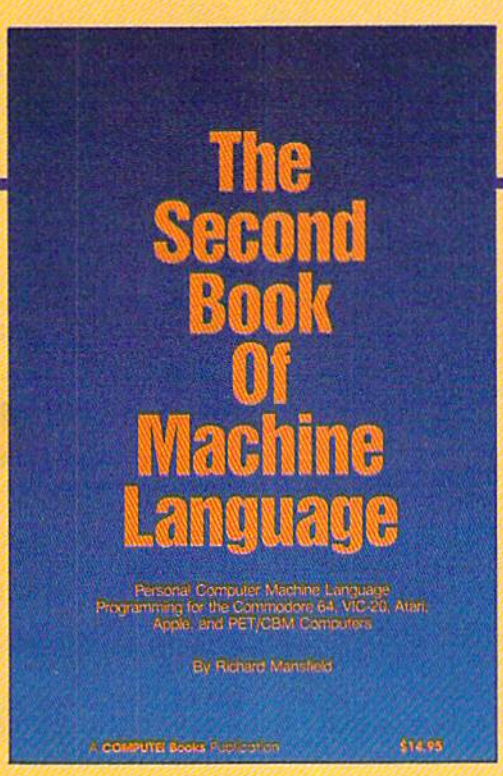
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2040 disk. The disk is effectively write-protected.

This is *not* the same as copy-protecting the disk. There is one exception: Programs such as *Copy-All*, which copy an entire disk to another, may work only until track 18. After the DOS flag is copied, the destination disk will be write-protected and subsequent files may be corrupted.

People can still copy individual programs, loading them and saving to another disk. But they won't be able to scratch anything from your disk, or add anything to what's there.

After altering the flag, you can open and read files, and load programs. You won't be able to save, write files, rename, scratch, or validate the disk. The only DOS command you can use is "N0:name,id" to reformat the disk (and you'll lose all programs and files on the disk).

Unprotecting A Disk

Changing this byte is very easy to do with the Block-Read (U1) and Block-Write (U2) commands. But what happens if you change your mind and want to write to the disk again? Putting a $41 back into the flag would reverse the process, but the write-protection prevents you from making the change. It seems the only way to write to it again would be to reformat the disk.

We can do it, but first we must fool DOS again. This time we make the disk-drive think it is a 2040, using the Memory-Write (M-W) command. This command is similar to a POKE in BASIC. But instead of putting a number into the computer's memory, we're changing values inside the disk drive's memory. After doing the Memory-Write, a Block-Write restores the flag to normal.

Using Disk Lock

Type in the program, but don't run it (yet). Save it first. You won't be able to save it to a locked disk.

It's very easy to use, and runs on the VIC or 64. Load it, put the disk you want to alter in the drive, type RUN, and the prompt "(L)OCK OR (U)NLOCK" will appear. Press either L or U and the program changes the flag byte. A second or two later, the program ends. If you want to lock or unlock another disk, change disks and type RUN again. That's all there is to it.

You might want to mark the disks you've locked by writing an "L" on the label. Use a felt-tip pen, rather than a pencil or ballpoint, to avoid damaging the disk. The primary value of "Disk Lock" is to prevent accidental scratching of important programs on archive or backup disks. Don't lock all your disks, or you won't be able to save anything to them.

A word of caution: The program contains some powerful disk commands, which might irretrievably garble information on a disk if entered incorrectly. Be sure to type the program exactly as listed. A comma or semicolon in the wrong place (or missing altogether) could cause many problems. After entering the program, test it on a new disk (or an unimportant one) before you begin to lock important disks.

```
10 OPEN15,8,15:PRINT#15,"I0":OPEN2,8,2,"#
   "                                  :rem 27
20 PRINT#15,"U1:";2;0;18;0:GOSUB1000
                                      :rem 10
30 PRINT#15,"B-P:";2;2                :rem 188
40 PRINT"(L)OCK OR (U)NLOCK":INPUTA$:IFA$
   ="U"THEN70                         :rem 54
50 IFA$<>"L"THEN40                    :rem 246
60 PRINT#2,CHR$(1);:GOSUB1000:GOTO100
                                      :rem 177
70 PRINT#2,CHR$(65);:GOSUB1000        :rem 232
80 PRINT#15,"M-W";CHR$(1);CHR$(1);CHR$(1)
   ;CHR$(65)                          :rem 241
90 PRINT#15,"M-W";CHR$(2);CHR$(7);CHR$(1)
   ;CHR$(65)                          :rem 249
100 PRINT#15,"U2:";2;0;18;0:GOSUB1000
                                      :rem 58
110 CLOSE2:PRINT#15,"I0":CLOSE15:END
                                      :rem 154
1000 INPUT#15,EN,EM$,ET,ES             :rem 4
1010 IFENTHENPRINTEN,EM$,ET,ES        :rem 158
1020 RETURN                           :rem 163
```

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HORIZONS

Charles Brannon
Program Editor

Perhaps no recent hardware product has piqued as much interest and curiosity as the Okimate-10 printer, first mentioned here in the CES feature story in the September GAZETTE. Three qualities of this printer are apparently responsible for the Okimate's appeal: low price ($239 with Commodore interface); quiet, good quality printing (via a special nine-wire thermal transfer printing element); and most importantly, color. Readers became a little impatient, writing to ask us why we haven't reviewed the printer yet. An evaluation model arrived recently and we can now report on the features and shortcomings of the Okimate-10.

Removing the Okimate-10 from the packaging, you are first impressed by its small size. The printer is about two-thirds the height and somewhat less than the length and width of the 1541 disk drive, yet can transport full 8-1/2 × 11 inch paper, either a single sheet at a time using friction feed, or computer paper continuously. The manual says almost any smooth paper can be used; more on this later.

The printing technology, called *thermal transfer*, is fundamentally different, yet similar to existing printer technology.

Impact dot-matrix printers print by sweeping a vertical column of pins across the paper. When a dot needs to be printed, a solenoid behind the printhead forcibly strikes a tiny metal pin against the ribbon, transferring a bit of ink onto the paper. Text is printed a column at a time, each column being one dot wide, rather than a full character at a time (as in the case of letter-quality printers, which stamp out fully formed characters much like a typewriter). The disadvantage of impact printing is that these little pins stir up a noise storm, screeching like fingernails scratching a chalkboard.

Fire Writing

There are two variations of thermal dot-matrix printing. Characters are formed as in impact printing, one thin column per firing, but instead of using kinetic energy (the force of impact) to transfer ink from a ribbon, thermal energy (heat) is used to change the color of the paper. The ink is built into the paper, so to speak. One kind of thermal paper merely darkens when heated. The other kind of thermal paper is inherently dark, but coated with a thin white-sheened aluminum layer. The thermal element flash-heats tiny points in the printhead, which either darken the paper, or vaporize the light coating to reveal the underlying dark coloration. Thermal printing is whisper quiet compared to the staccato shriek of an impact printer. However, the special paper used in thermal printing is not only expensive, but thermal paper (not aluminized paper) can darken as it ages—quite quickly if kept in a hot environment.

Okimate's thermal transfer is a synthesis of existing technology. At the instant of printing, paper, ribbon, and printhead are forced together. Tiny hot points in the printhead glow for the briefest moment. In that moment, a small bit of waxlike ink is melted off the ribbon and fused to the paper. Alternatively, the ribbon can be left out, and you can use heat-sensitive paper, as with a thermal printer. Thermal transfer shares thermal printing's quiet manner, yet can print on ordinary paper.

Unfortunately, you can't use ordinary inked ribbons. Like carbon film ribbons, a thermal transfer ribbon is not re-usable. When a bit of

/"Hi, we're from Europe. Where's the gold?"/

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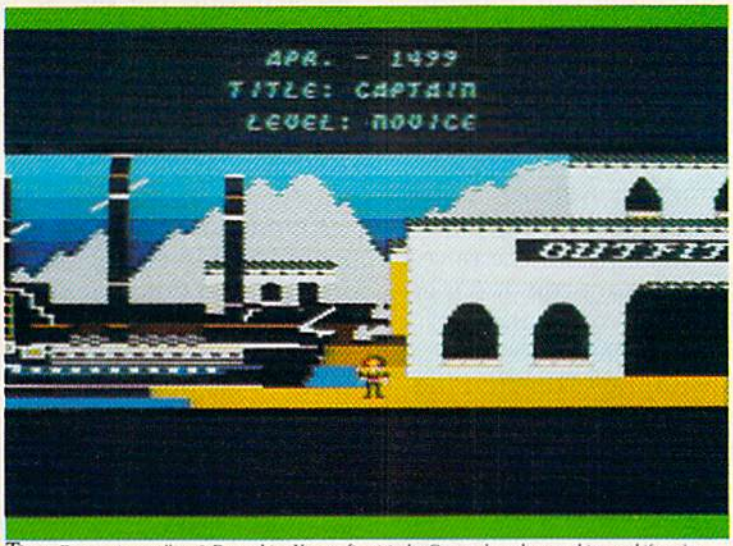
It's a kind of adventure. An unusually rich and technically impressive one with new continents to explore, natives to encounter, resources to manage and trade routes to establish. But beyond all the neat stuff *Seven Cities* throws up on the screen, there's something else happening here.

It feels quite odd to look at the map and see nothing. Of course you have to explore the more than 2800 screen new world in order to map it. But the way the natives act, the way you get older, the way seasons change and your men behave, and the way your reputation preceeds you gives you a sort of feeling that's unexpected in computer games. It's deeper. Maybe a little disquieting. It plays as much in your head as it does inside your computer.

Seven Cities does all this with the real world or, better still (since the "new" world really isn't anymore), it will construct any number of completely detailed hemispheres for you to try your hand with.

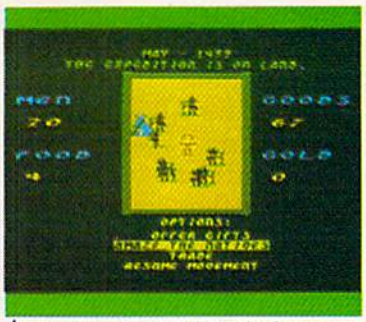
Designed by Ozark Softscape (the people who made M.U.L.E., *Infoworld's* "Strategy Game of 1983"), *Seven Cities* is about as near a recreation of history as has ever been accomplished, with or without a computer.

Find it. Stomp around in it. See if you can't do a better job than all the celebrated figures who got us into the mess we have to deal with today.

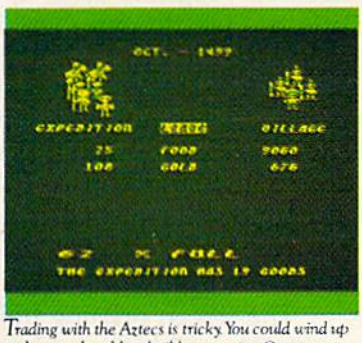


This is Europe, in scrolling 3-D graphics. You outfit, visit the Crown, launch your ships, and if you're cut out for this, you return later to tell all sorts of wild stories about what it's like over there.

There are over 2800 screens to explore in the new world. As you scroll through them, seasons change.



Animated natives surround you. They have no reason to trust you. The drum beat quickens.



Trading with the Aztecs is tricky. You could wind up with enough gold to build an empire. Or as soup.

Home again you view your maps, pat yourself on the back, and consider your place in history.

SEVEN CITIES *of* GOLD™

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ink is melted off, an inkless hole is left behind. If the ribbon were rewound and reused, there would be gaping white spaces in printed text. The black ribbon is good for about 75 average pages of text, according to Okidata. Replacement black ribbons cost $5.95. So what money you save by using ordinary paper may be used up by the cost of new ribbons.

Even though thermal transfer can print on any paper, nobody makes any claims for the quality. Because the ribbon is sandwiched between the paper and printhead, close contact is required to smoothly transfer melted ink. Rough paper, such as bond, has too many nooks and crannies to permit good transfer. Rub a soft lead pencil across such paper and you can see this grain. Thermal transfer prints only on the raised surface of the grain, so printing on rough paper is spotty, as if the ribbon were worn out. We tried several kinds of common paper: the special glossy paper that comes with the Okimate Plug 'n Print interface kit, ordinary fanfold computer paper, smooth photocopy paper, letterhead (bond), and clear acetate. Only the acetate yielded a clear, sharp image (perfect for overhead projection). The print on the special smooth paper was acceptable, but a little lighter than desired. A sliding switch on the Okimate-10 lets you adjust the darkness of the print, but you would always want to leave it in the darkest setting.

All the other types of paper we tried gave unacceptable results, with the bond paper providing illegible print. Standard computer paper was too rough. Even the rather smooth photocopy paper looked like it was printed on by an impact printer with a worn-out ribbon.

We haven't found a commonly available source of extra-smooth paper, so even though you *can* use any paper, in practical terms you will most likely want to use the special paper provided by Okidata. Extra paper can be ordered from Okidata at $9.95 for 250 sheets.

Plug 'n Print

Okidata is to be congratulated for the consumer orientation of this printer, evidenced in both the style of the manual, and in the ease of setup. The basic Okimate printer is deaf and dumb, with a deep hole in its side. Unlike some printers which use a Centronics plug, requiring an external interface, the special Okimate interface is a cartridge which plugs into the side of the printer. After you plug in the interface, you snap a faceplate over the interface, then simply plug in the included Commodore serial cable, and you're in business. Don't look at the price of this printer ($169.95) without the interface. If you already have a printer interface, it won't work with the Okimate. Besides, the ribbons and glossy paper come with the interface.

After this installation, you basically have a thermal transfer MPS-801, with a few bonus features. The interface module completely customizes the printer, making it compatible with the codes and modes of the 1525 or MPS-801 printer. You can LIST programs to the printer at 60 characters per second (cps) and see all the graphics characters and cursor controls in the listing. The text is well-formed in a 9 × 9 matrix, with full descenders (tails) on the lowercase letters g, j, p, q, and y. The Okimate-10 uses the 1525/MPS-801 codes and secondary addresses for cursor up/down mode, elongated text, graphics mode, dot positioning, etc. Additional features include small characters, bold characters, forced paging, and automatic skip over perforation on fanfold paper. You can run all Commodore software confident that your printer will behave like the less glamorous MPS-801.

A Rainbow Machine?

It seems I've neglected to mention the Okimate's strongest feature—color—but I'm not prepared to call this a color printer without some qualifications. It is a printer capable of color, and even though the quality of color images can be exceptional, there are several drawbacks.

The first problem is software support. It is not made clear in the manual how to program color yourself, and it's no piece of cake. The only software for color printing is a demonstration program and a color high-resolution screen printing utility. The demonstration program is attractive, and shows off the printer's skill at handling both black-and-white and color text and graphics. This program exists in versions for both the VIC and 64, though there is no software support as yet for the Plus/4 and Commodore 16 (the printer does work with these computers, although you might occasionally get ?DEVICE NOT PRESENT ERROR). The Plug 'n Print package contains the software, on both tape and disk. The tape holds a smaller version of the demo program, and lacks the color screen printing utility.

The screen printing utility reproduces 16-color multicolor and high-resolution graphics screens on the printer. It prints graphics produced and saved to disk by one of several supported commercial drawing programs. Packages currently supported are *Doodle!, KoalaPainter, Supersketch,* and *Peripheral Vision.* There is also an option for printing user-created pictures saved in a special format. The pictures are rather faithfully rendered, with most colors looking at least similar to the original. The biggest problem is that each

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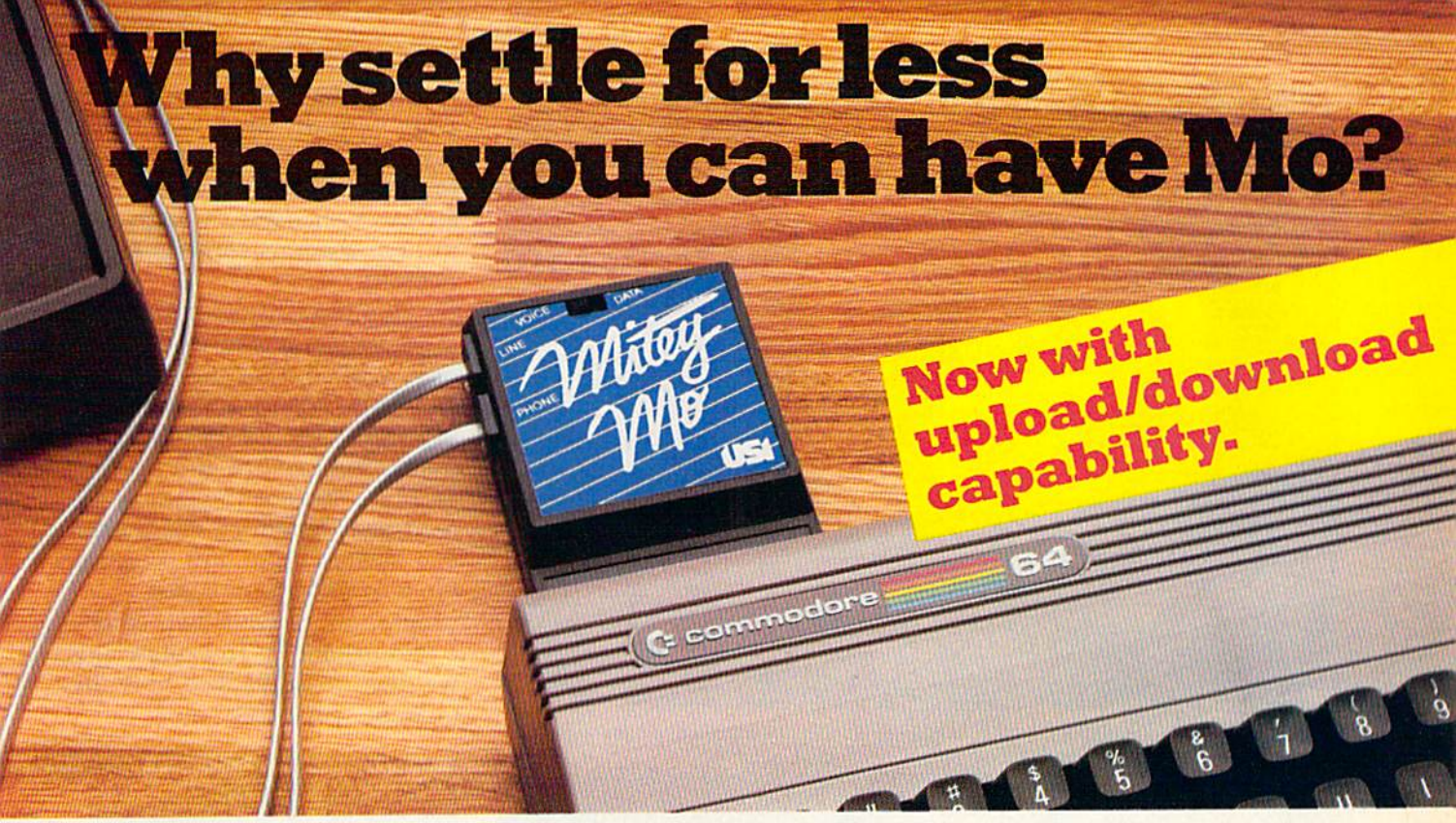

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Photo courtesy of Koala Technologies.

The first picture above is a photo taken from the Commodore 1702 color monitor. Below is the same picture printed on the Okimate-10. Notice the minor differences in color and proportion. The Okimate-10 cannot exactly match the Commodore colors, and pictures tend to be printed wider on the paper than they are on the screen.

printed line does not smoothly align with the next, which leaves thin horizontal gaps in the picture. These lines are not always noticeable, though, since printed sections sometimes overlap.

It's too bad there's not more software that works with or is available for this printer. It would be ideal if Okimate provided a "snap-shot" program that could capture and print graphics screens (including colored text, redefined characters, and sprites) from any program. It's also unfortunate that programming your own color is a tedious affair. To explain this, we need to delve into how the Okimate produces color.

Secrets Of Okimate Color

The Okimate-10 seems to be essentially a black-and-white printer which has been adapted for color. With only minor changes and a special ribbon, any printer could be trained to print in color. The Okimate-10 capitalizes on a simple trick to generate its color, though this does not detract from the fact that color prints look excellent, though not comparable in quality to a photograph or color slide of a computer screen.

The review in this column of the late MCS-801 color printer pointed out that it generated color by printing across a four-color ribbon. The ribbon is installed at a 45-degree angle, permitting the head to strike all four colors in a single pass. This defines the nature of the MCS-801. It's a color printer that could act like a black-and-white printer, whereas the Okimate-10 is a black-and-white printer capable of color. The Okimate-10 uses a three-color ribbon, but cannot print in all colors in a single pass across the carriage.

The normal black ribbon is a single strip of waxy ink on

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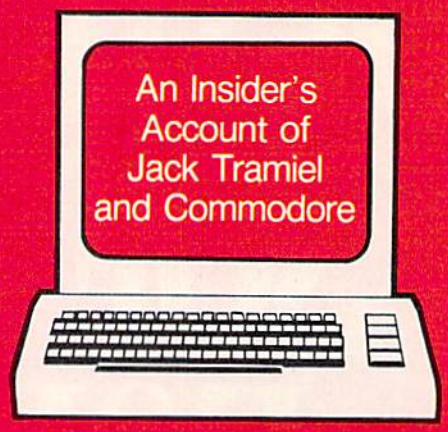

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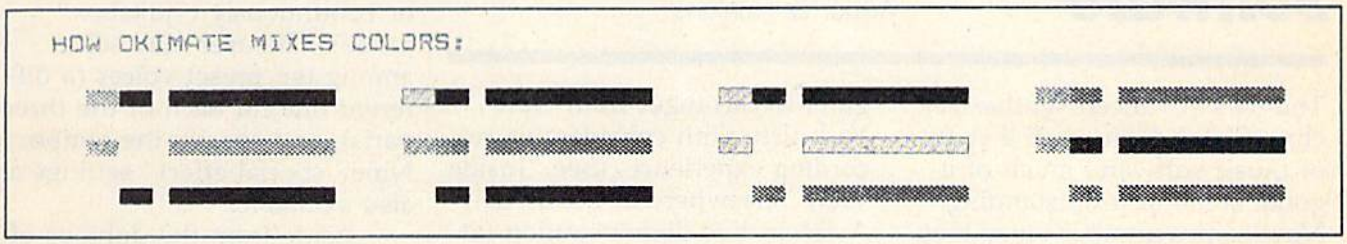
plastic. The color ribbon is a series of colors accessed sequentially. Each colored section is about eight inches long, the width of the paper. The series starts with a clear plastic leader, a length of yellow ribbon, then magenta, cyan, and a small unused black segment. This series is repeated over and over again in the ribbon. To print in color, the three basic colors are combined to give you seven secondary colors. Here's how it works: yellow + magenta = red, yellow + cyan = green, magenta + cyan = blue, and yellow + magenta + cyan = black.

To get all these colors, three sections of ribbon must be used. The printer returns the carriage after it prints in one color, then overstrikes in the next color. Therefore, it takes more than three times as much time and ribbon to print a single line in color. All three segments must be used, even if you only want to print a single black dot. And if you only want to print in cyan, you still must skip past (and waste) the yellow and magenta segments. In practice, all three segments must be fed through, since the printer synchronizes itself with the yellow segment at the start of each new line.

To program color yourself, you send a command that tells the printer to feed ribbon until it finds the clear marker strip. This leader is immediately followed by a yellow segment. You know that the yellow segment is (not coincidentally) a full line wide, so you print whatever text or pixels you want in yellow, or whatever parts of text or pixels that should use yellow (as in red). Even if you don't print a full line, the printer is now in color mode, so it feeds in the magenta section next, discarding any remaining yellow. The printhead stays on the same line. Now you print the magenta portion or portions that require magenta, such as red. You overstrike yellow from the previous pass to create red. You continue with cyan, printing cyan sections or overlaying to give blue, green, and black. After the cyan section is used, the printer skips over the clear section and is ready to restart the next line in yellow.

You have to carefully coordinate your program so that it overstrikes properly. If you just dumped text out to the printer, it would print some of it in yellow, the next part in magenta, then cyan, etc.

With dot-programmable graphics, you can create colored pictures as well. The Okimate screen print program uses a trick known as *dithering* to create extra colors. Dithering places two colored dots side by side, rather than mixing them. From the right distance, a magenta dot next to a cyan dot looks like a fat purple dot. Television pictures work on a similar principle. Checkerboard patterns are either overlaid or interleaved to simulate light colors (alternate with white, which isn't an ink color but the lack of one, as long as you use white paper), or new colors such as apple green (alternate green and yellow). The accompanying figure shows how colors are mixed.



With this technique, you could get well over 40 possible colors. The color screen print program does a fair job of dithering the seven secondary colors to give the 16 colors used on the Commodore 64.

The problems with Okimate color now become evident. Although the ribbon cartridge allows quick, easy, and clean ribbon installation, it limits the quantity of ribbon. If Okimate chose to use a longer ribbon, the printer would have to be physically bigger as well to hold a larger ribbon cartridge. Color printing must always use three segments of ribbon, more than 24 inches per printed line. This uses up a ribbon three times as quickly, a ribbon that can only print 75 pages in black. You get about 10 color pages per ribbon, by Okidata's estimation. Each ribbon costs $6.69.

Due to inevitable ribbon waste, some have suggested that you get more like 6–8 pages of color printing on the average. Overall, though, the Okimate-10 is an inexpensive, good quality printer, suitable for everyday listings and word processing, as well as for art. Its low decibel operation lets you print late into the night without giving your family or roommates nightmares. True Commodore compatibility makes the Okimate-10 an alternative to the MPS-801 worth considering.

Okimate-10 with Plug 'n Print kit
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REVIEWS

Sight & Sound Music Software

Arthur B. Hunkins

The 64's advanced synthesizer chip, SID, has inspired a spate of music software, much of it good, some of it outstanding. Now comes another entry that stands with the best: *Sight & Sound Music Software.* Sight & Sound, the company, is entering the market with a bang—11 new disk-based software and hardware products. This is *significant* software, attractively produced, and accompanied—for the more complex packages—by superior documentation.

A sampling of these new products is reviewed here, including two of four Computer Song Albums (*On Stage* and *Music Video Hits*), a mini-musical-keyboard overlay (the "Incredible Musical Keyboard"), and two important performance and/or arranging packages—*Kawasaki Synthesizer* (a two-disk performer/composer package) and *Music Processor.* I also received demos of the *Kawasaki Rhythm Rocker, Music Video Kit,* and *3001 Sound Odyssey,* and I've included a more brief look at these, too.

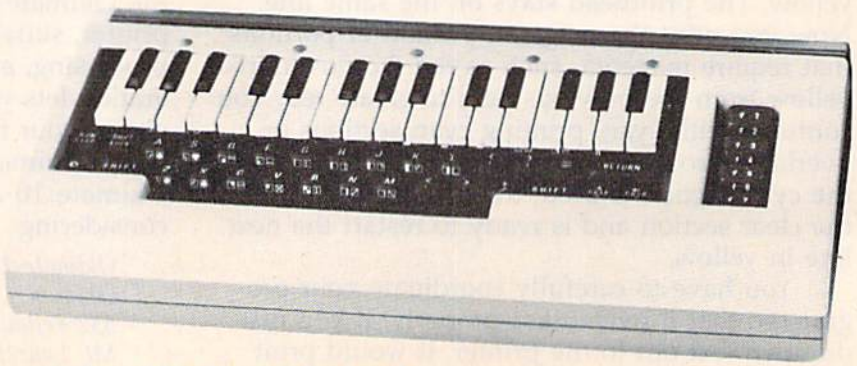
The programming geniuses behind *Sight & Sound* are Peter Englebrite and Ryo Kawasaki. Although Mr. Englebrite's credentials are not given, Ryo Kawasaki is a well-known jazz guitarist/arranger from New York City with considerable recording experience. (See "Inside View" elsewhere in this issue.) A recent live demonstration (at a national music merchandising show) of his *Rhythm Rocker* and *Synthesizer* programs running together on two 64s—with Kawasaki alternately performing on each—was *very* impressive. These packages clearly have commercial grade, live-performance applications.

LPs On Disk

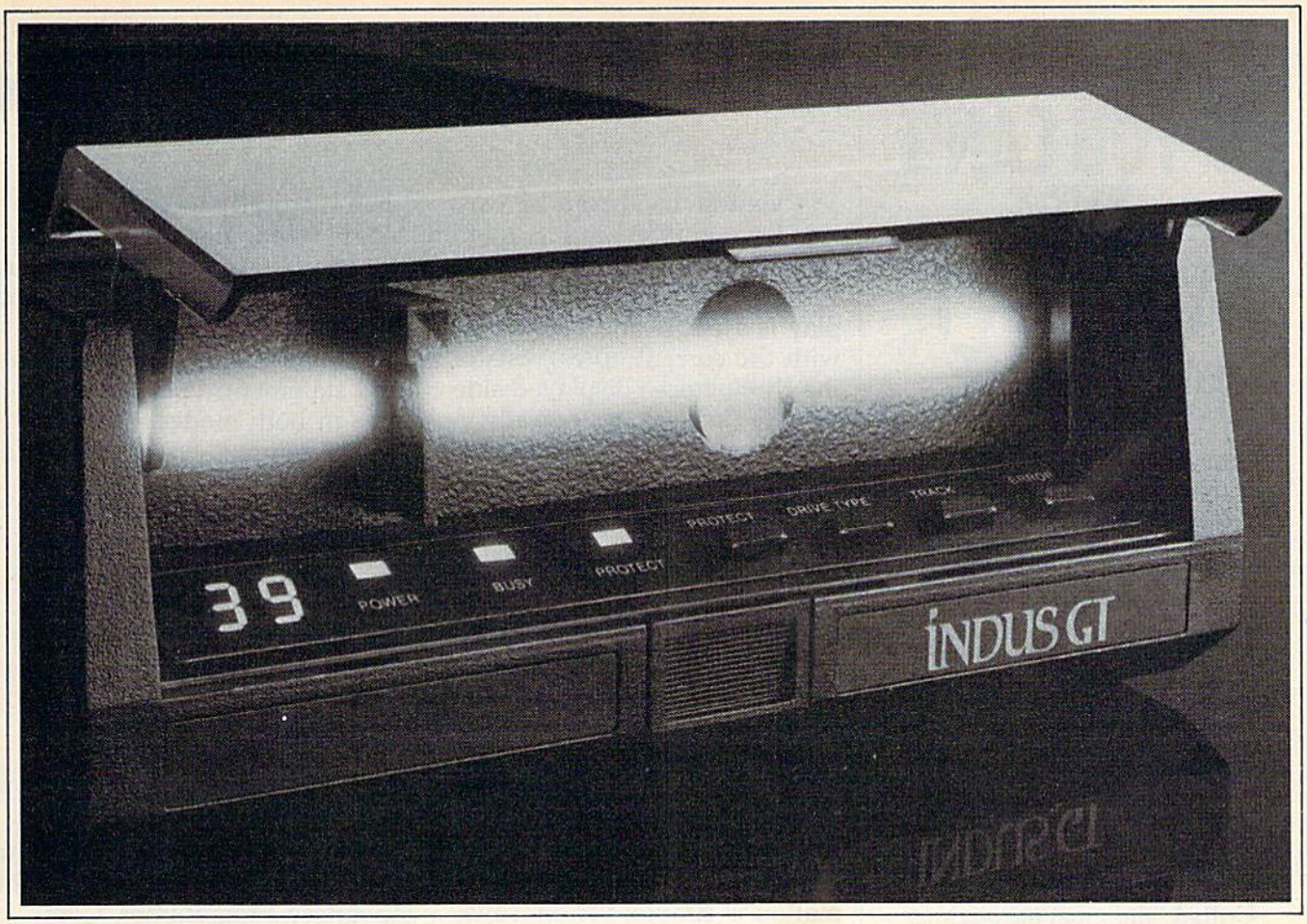
Let's begin with Peter Englebrite's *Music Processor,* the creative vehicle behind a major projected series of "computer LPs," the Computer Song Albums. Each album (*Music Video Hits* and *On Stage* were the two reviewed) consists of eight arrangements of current hit tunes. They can be played back singly, or continuously ("jukebox" mode). The user may select among ten preset voices (a different one for each of the three parts), and specify the tempo. Nine "special effect" settings are also available.

Aside from the dubious effects, the only point to question—the arrangements are otherwise quite good—is the instrument selection. Some of the choices are slightly off the wall. Most of the voicings are sustained; few short, lively options are included (this makes the arrangements somewhat bland, especially in conjunction with the unvarying volume and instrumentation).

Of course, instruments, tempo, and effects can all be varied "on the fly" by the user. Indeed, several important customizing options are available: Arrangements can be edited on the *Music Processor* (instruments



The Incredible Musical Keyboard



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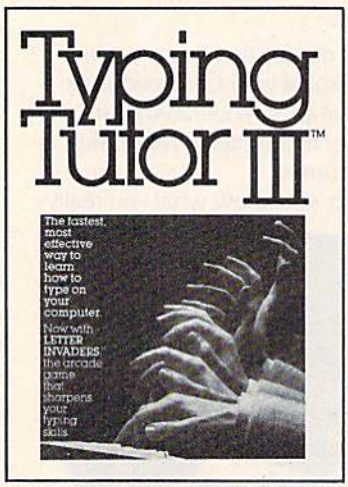
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and volume levels can be varied, for example), and animation may be added with the *Music Video Kit.* The normal video display is a treble and bass staff with the current notes/rests of the three voices displayed side by side (instead of vertically, as in musical score). For music with lyrics, the "sing-along" text is printed on the bottom two screen lines.

Englebrite's *Music Processor* is an excellent, powerful piece of composition/arranging software. Fourteen arrangements are included in the package, which is compatible with the *Music Video Kit.* A hint of this exciting potential is offered in the video accompaniment to *Kites* and *Squirm*, where the semi-abstract, hi-res color animation is simple, yet effective. *Music Processor* (like the *Kawasaki Synthesizer*) optionally makes use of the "Incredible Musical Keyboard" (see below), which is highly recommended. On the other hand, we should point out that *Music Processor* implements *all four rows* of the 64's keyboard as pitches, whereas the "Incredible Musical Keyboard" uses just the top two.

A Choice Of 99 Instruments

A total of 99 instruments are available, ten of which can be used during actual performance, as with Computer Song Albums. Both an Edit and a Step mode are employed for note entry. Notes can either be typed in using the alphanumeric keys, or "played" as on a piano keyboard (the "Incredible Musical Keyboard" is indispensable here). In either case, music is entered a voice at a time; files of individual voices are saved, then magically merged into a single score. You can even create special accompaniment files, which you can save, reload, and play along with.

Many different commands and statement types are available in both modes. Instruments, tempos, text display and accentuation, colors, repeats, and other options can all be specified, and changed at any point in the arrangement. Step mode permits instant playback and editing, then moving either forward or backward to the next note.

As with Song Albums, a "jukebox" play mode is available. The program contains some powerful features not apparent (nor readily accessible) to the novice, but intriguing for the advanced programmer. Computer keys can be redefined for performance purposes. More importantly, the preset instruments *can be redefined*; the arranger can actually change any SID chip parameter through programming. It's not simple, but it is possible.

"The Incredible Musical Keyboard"

It's open to debate just *how* "incredible" the "Incredible Musical Keyboard" (IMK) really is. This simple keyboard is clearly cost effective, mechanically reliable, and most useful for performing and coding data. It also comes with a very attractive post-90-day-guarantee replacement offer: $10, or free with software order—which could be as low as $25. IMK is a plastic, color-coordinated, nearly two-octave, miniature keyboard overlay that uses the top two rows of the 64's keys. The principle drawback is its tiny keys, which are shallow as well as

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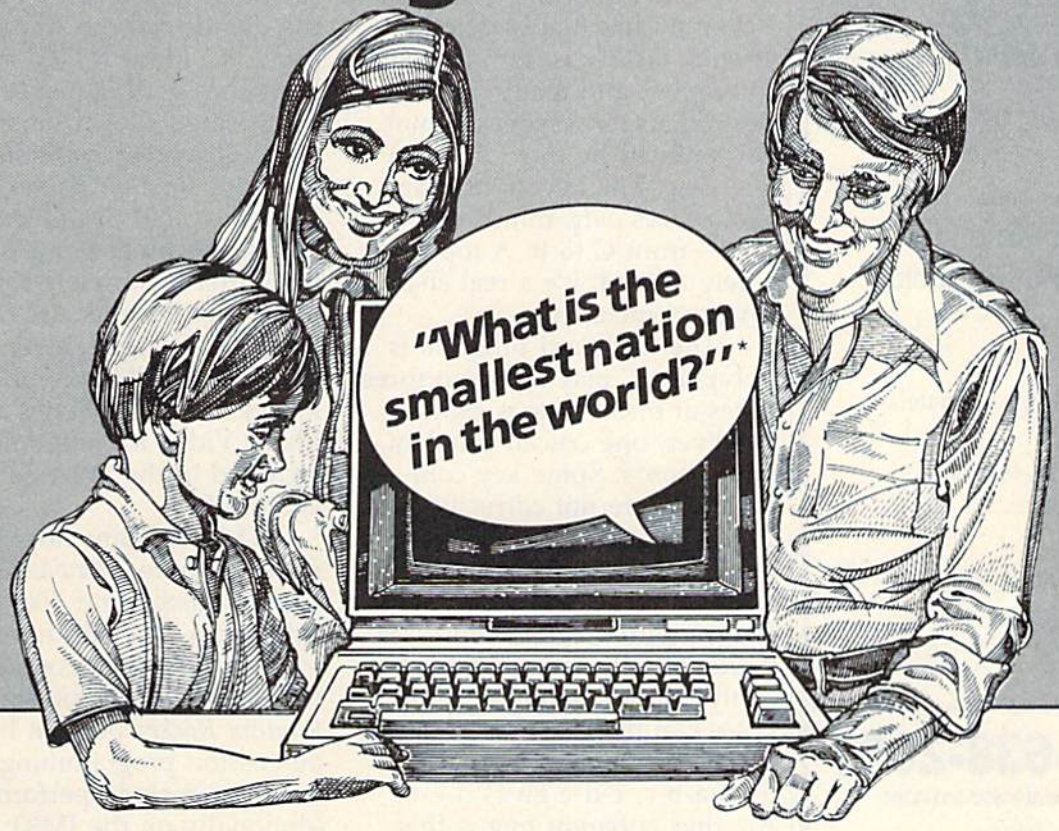

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REVIEWS

narrow. To achieve any speed, a new playing technique is required. On the other hand, as Kawasaki has amply demonstrated, facility is not impossible to acquire; and many performers/arrangers will not be inhibited by this format in any case. The keyboard spans *two octaves only,* minus one note—from C to B. A top C is sorely missed; it's a real shame it wasn't included.

The keyboard program is polyphonic, playing up to three notes at once. It does exhibit, however, one crucial problem with chords: Some key combinations are not correctly encoded. This is not to be blamed on the keyboard or software; it's a problem caused by the way the computer reads keypresses. Although all triads work correctly, other combinations of notes can be disastrous: For example, a-c-d gives b-c-d, as does a-b-c; c-d-e gives d-e-f. Another apparent bug is that "held" voices sometimes retrigger when other voices move. All voices have the same tone color with IMK software (this is not required in *Kawasaki Synthesizer*—see below).

On the positive side, a considerable variety of menu options is available to the user during performance. You can choose slide or vibrato, one of three instruments (piano, synthesizer, or bass), specify volume and octave, or insert Pitch Bend, which slides *upward* only; it hops back down to the original pitch when released. The Slide is single speed-moderate (it gives unpredictable—if fascinating—results in chordal settings).

The real bonus in this package, however, is the comprehensive demo of Sight & Sound software. (For display purposes, the demos can run in perpetual rotation.) Indeed, IMK is probably worth getting just to look at all these goodies. Demos include: *Kawasaki Synthesizer, Kawasaki Rhythm Rocker, Music Processor, 3001 Sound Odyssey,* and a Computer Song Album (the latter a complete rendition of "Sweet Dreams Are Made Of This," with highlighted, "bouncing ball" text.) *Music Processor* even includes a brief Music Video Kit animation not included in the *Processor* package itself.

The programs not otherwise reviewed here—*Kawasaki Rhythm Rocker* and *3001 Sound Odyssey,* a SID chip tutorial and panel synthesizer/composer—both appear to be outstanding. *Rhythm Rocker* permits bass and percussion programming against real-time melody performance (optionally on the IMK); it integrates hi-res, coordinated color graphics into a single program—a veritable media tour de force.

Equally impressive, in a different way, is *3001 Sound Odyssey.* This electronic music tutor is a catchy, animated introduction to digital hardware synthesis. The synthesizer portion of the program is a virtually complete implementation of SID; it includes not only filter enveloping (through ADSR3), but permits use of oscillator three as a control in the sub-audio range. This may well be *the* way to introduce electronic music concepts and experiences to young people. The method appears conceptually sound and powerful, as well as clever and inexpensive.

The *Kawasaki Synthesizer*

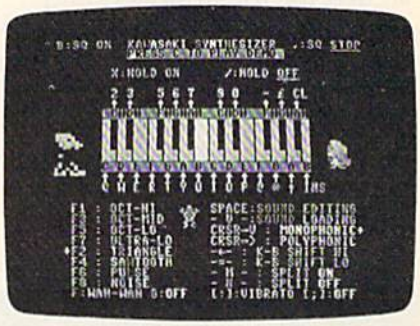
Kawasaki Synthesizer is a two-disk package consisting of *The Performer* and *The Composer*. *The Performer* works with either the Commodore keyboard (top two rows) or the "Incredible Musical Keyboard." You can use vibrato, pitch bend (again, *up* only, hop down), or sweep (a giant sweep up, switching down on release). There are also a synchronized graphics/music demo, Kawasaki Space Dance Theatre, 21 preset instrumental/effects options, and 13 songs—including two "LPs" (which illustrate *The Composer*'s multifile chaining mode). Each of the presets can incorporate any of the four waveforms, including noise, which are selectable independently of the instrument. You also choose monophonic or three-voice polyphonic mode, and have the option of playing the lead line to a "bass and drums" sequenced accompaniment. As with *Music Processor*, the program has some trouble decoding certain combinations of keys (chords).

A more important disk is *The Composer*. In contrast to the *Music Processor*, *The Composer* is sequencer-based. Time is marked in beats; each beat is a single sequencer stage where an event (or rest) can "happen." There are 255 stages per memory bank, and nine banks. Each voice requires a different bank, so that the (up to) three voices must divide up the nine banks. There are many possibilities.

Two main displays are used: the Keyboard Page and the Sound Editing Page. The Keyboard Page permits performance using the upper rows of the 64 keyboard, or the IMK. You have options of accompaniment sequence, choice of waveform, keyboard octave, wah-wah, and vibrato. You can also select monophonic or polyphonic mode. Monophonic mode offers a split keyboard (in halves), with considerable distance between the two octaves. In contrast to other programs, *Synthesizer* implements different tone colors for polyphonic voices (when they have been previously defined on the Sound Editing Page). There are some limits to polyphonic mode, not the least of which seems to be a major bug: The notes apparently cannot be stuck together. In the split keyboard mode, there are also tradeoffs: no vibrato, and no polyphony.

On the Sound Editing Page, instruments are created and parameters set. Here is a wide range of options for recreating individual voicings (sets of three are saved as "sound files" independent of compositions). You can easily specify envelopes, filter and pulse-width settings, and effects (ring modulation and sync). You also make basic waveform selection, but only after opting for a separate Mixer page.

Most, though not all, of SID's capability is implemented here, including those features most useful and relevent to the traditional performer/arranger. Certain choices have been simplified: only eight preset pulse-widths, resonances, and filter cutoffs are provided. The user should also be aware that a certain number of sound parameters are *not* saved as part of a sound file; these include octave selection, wah-wah, and vibrato, which must be manually entered. A big help is the presence of a "play note" key, which allows you to instantly hear a voice at any given point.



The main menu for the Kawasaki Synthesizer.

Note sequences (that is, compositions) are entered by playing keys one sequence step (beat) at a time. There is even a special *rest* key. Pitches are also entered one *voice* at a time. The sequence display is color-coded, with appropriate pitch names so that note files can be easily and accurately deciphered. Documentation is superb; and particularly when working from the Sound Editing Page, it is *required* for steering through the intricacies of note entry, editing, saving, bank switching, etc. (Numerous onscreen reminders help greatly, but additional aid is needed.)

Performer Or Arranger?

To compare *Kawasaki Synthesizer* with *Music Processor* in terms of composing/arranging is difficult. They represent two quite different approaches and styles. *Syntheziser* appeals more to the keyboard performer; it is faster

and intuitive, more spontaneous. *Processor* is primarily designed for the arranger, and reflects a more abstract orientation. Here one might work from a score, do more pre-planning, be interested in greater programming power and flexibility. One important difference: Instruments and instrument definitions can be changed during a *Processor* arrangement; they remain *fixed* in *Synthesizer*. My advice is to pick the program that best suits *your* methods.

All of these products (Computer Song Albums excluded) are important software/hardware contributions to 64 music synthesis. They are reasonably priced, brilliantly programmed, attractively packaged. They are useful to hobbyists, for an introduction to electronic music, as a vehicle for creative experimentation, even for commercial applications. *Sight & Sound*'s approaches to "making music" are varied, and appeal to different needs. In summary, *Sight & Sound* means top quality music software. I highly recommend their products to all music enthusiasts.

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or she has done so. And if the program is done exactly right, the student will return to it again and again.

The Factory and *The Pond* are two educational games for the 64 from Sunburst Communications which explicitly attempt to teach pattern recognition. According to the packaging, they're designed for ages seven and up, but Sunburst's flyer lists *The Factory* as nine to adult. No matter, for both are useable—with help from parents—by younger players as well.

Learning By Creating

The Factory asks you to build a factory in order to make a product. The opening page asks you to choose one of three activities: Test a Machine, Build a Factory, or Make a Product. Testing a machine is essentially a demonstration of each of the three types of machines available. To build a factory, you combine machines to create a unique product. The game appears in the third option, Make a Product, where you are shown a product and asked to match it.

The product you begin with is simply a square of "raw material." With the help of three types of machines, you can turn this raw material into a finished product. The Punch machine lets you punch either round or square holes in the material. You can command the machine to punch one, two, or three evenly spaced holes. With the Stripe machine, you can paint a stripe across the middle of the material. Thin stripes, Medium stripes, or Thick stripes are all possible. Finally, the Rotate machine turns the material 45, 90, 135, or 180 degrees.

The Factory *teaches the child how to use machines to build a product.*

The idea is to use a combination of machines to create a unique product. When building a factory, you can use up to eight machines—in any combination of the above three types—to create an attractive product with stripes and holes. For instance, you can set up your factory so that the first machine will paint a thin stripe across the middle, the second machine will punch three round holes along that stripe, the third machine will rotate the material 90 degrees, the fourth will paint a thick stripe across the material, and so on. By combining the machines in the right order, it's possible to produce a very attractive product.

In Make a Product, the program gives you a ready-made product to copy. You must build a factory to produce that product. Three levels of difficulty allow you to tailor this activity towards just about any age group within the 6–16 range. A typical product in the Easy category would be one with a Thin stripe and a Thick stripe crossing at right angles. A Hard product would possibly have three stripes of varying thickness, three circular holes, and two square holes. The Hard series is instructive for any age group, including adults. It requires considerable thought to reproduce the product exactly.

One of the better aspects of *The Factory* is the distinction between being creative and being tested. Make a Product is a test, to see how well you understand how machines work together. Build a Factory, by contrast, is purely creative: You may build factories and create products to your heart's content, without worrying about failure or frustration. Sunburst obviously understands that there is room in education for both types of activity. In this sense alone, *The Factory* is a superb educational program.

A Frog Faces A Dilemma

The Pond is about a frog. What you do is help him find his way across a pond. He can get there only by hopping on lily pads, which are placed on the pond in some kind of pattern. You must tell the frog to hop a certain number of lily pads to the left, then a certain number to the right, then a certain number up, and so on. After you've given the frog the pattern, he'll follow it to see where he ends up. If you've been successful, he gets across the pattern; if not, he ends up in the water.

There are six different ponds, each representing a level of difficulty. Farmer Jane's ponds (the easiest) and Billy Bob's ponds require a two-step pattern. That is, the frog will have to jump a continuing pattern of, say, three to the right and one down. By repeating this pattern, the frog gets across the pond. The Puzzle ponds and The Lost Ponds are three-step patterns. The Maze ponds and the Twister ponds (the most difficult) are four-step patterns. A

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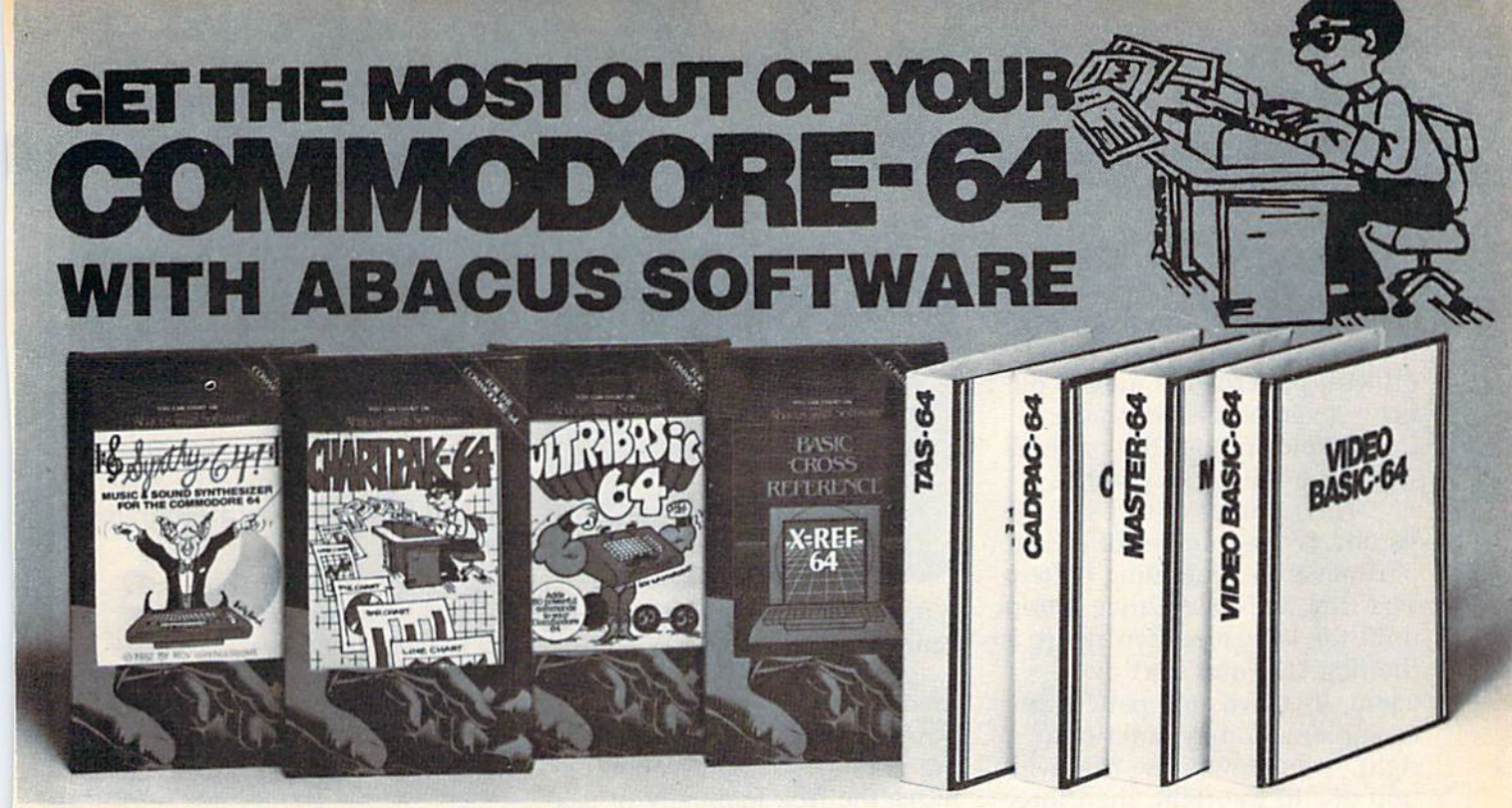

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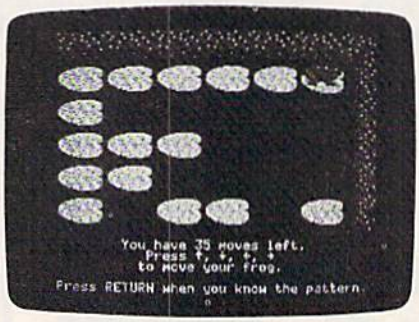
wide variety of patterns is available, so you will not likely see the same one too often. And the difficult patterns are indeed difficult; even adults will have trouble picking out the patterns without a fair bit of practice.

The number of steps in the pattern is the number of unique portions of a continuing pattern. The frog will follow that pattern until the last step, then return to the first step and start over again. In a two-step pattern, for example, you may enter one-right, three-down; the frog will hop one to the right, then three downward, one to the right again, three downward again, and so on. Naturally, four-step patterns are far more difficult to pick out; frequently the pattern is not complete on the screen when you start.

To help pick out the pattern, you may use the cursor keys to move the frog along the lily pads. After a few jumps, you should know it. In the hardest ponds, though, you may try several times before you finally understand the pattern. Often, as is the case in most pattern recognition exercises, the correct pattern is obvious only after you know it. If you're stuck, you can ask for help. The program will flash the correct pattern on the screen, or it will even show you the entire pond (at a different scale). Thus, frustration can be avoided.

The program is divided into practice and game. Practice is just that: You choose a pond and practice getting the frog across. The game portion is more involved, requiring that you complete three puzzles at each of the six ponds. You can play either solitaire or with another player.

Basically, the game portion



Pattern recognition is taught in The Pond.

involves losing as few points as possible. You start with 35, losing points each time you either move the frog manually or ask for help. For example, if you use the cursor keys to move the frog for seven lily pads—to find the pattern—you lose seven points. More seriously, if you ask to see the whole pond in the help menu, you lose 15 points. Thus, you lose the fewest points by asking for the least amount of help. At each new level, you get 35 new points to work with. By the time you reach the last two levels, you'll likely need all of them. The object of the game is simply to get through the Twister ponds first; if you succeed, the program provides a little graphic surprise.

Both *The Factory* and *The Pond* are appealing programs. Each has a Program Guide, a well-writ-ten, graphically detailed explanation of the program. The Program Guide leads you through the workings of the program in a tutorial fashion, so that getting into the game takes little time.

The programs may be too difficult for younger children to understand by themselves, at least without considerable practice. In both games, it may be necessary for a parent, or an older sibling, to start them off. After that, it will still be difficult for a seven-year-old, but fine for a slightly older child. This is far from a criticism, though, since it is best for a parent to supervise educational software use, anyway. Children above the age of nine, however, should be able to use and enjoy both programs easily.

The Factory *and* The Pond
Sunburst Communications, Inc.
39 Washington Avenue
Pleasantville, NY 10570
$34.95 each (disk)

Also Worth Noting

Eliza

Eliza is not a new product, but many readers may be unaware of this fascinating and instructive "computer psychotherapist" program which traces its history back to a mainframe computer at MIT.

In 1965, computer pioneer Dr. Joseph Weizenbaum created *Eliza* as a spoof of nondirective psychotherapy. *Eliza* asks questions, responds to your answers in nonjudgmental ways, and gently probes your thoughts and feelings. It remains an interesting experiment in artificial intelligence simulation, even if the program routines soon become obvious to you.

The Commodore 64 version of *Eliza* produced by the Artificial Intelligence Research Group has two attributes which make it well worth the $45 purchase price. First, it's a full equivalent

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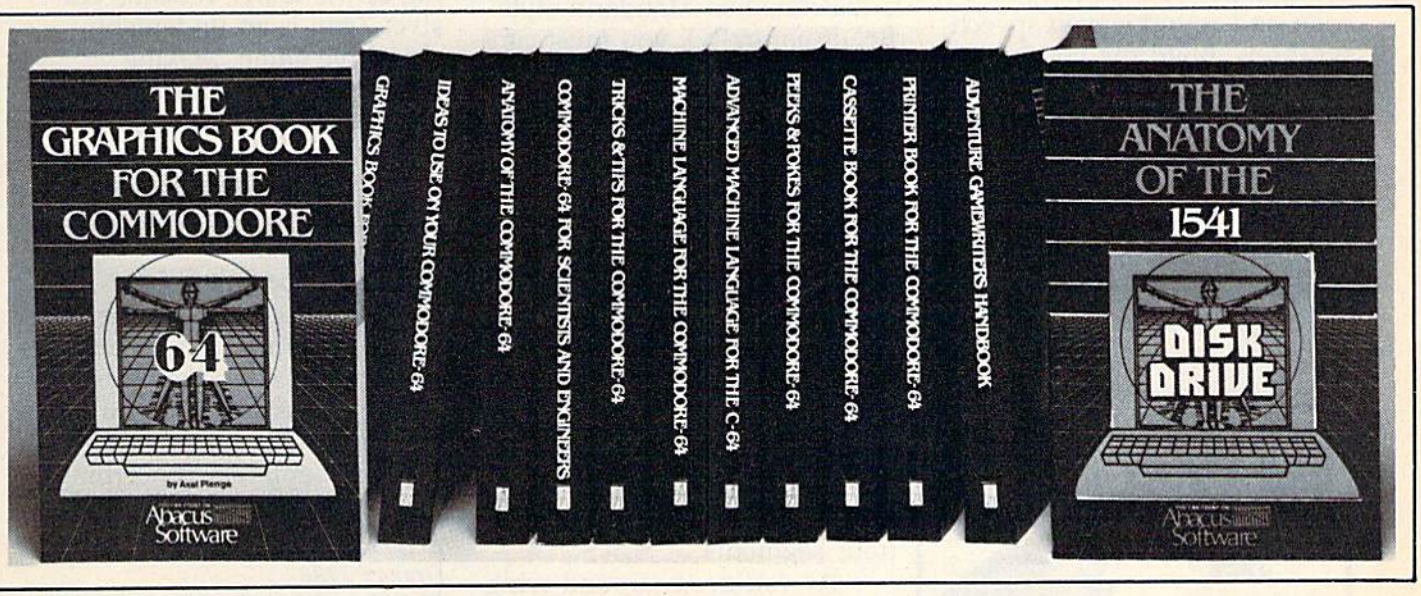
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of the original MIT mainframe program, employing the same conversational power that makes *Eliza* seem so human. Some other versions available are reduced in power and therefore in function. Second, the BASIC source code is unprotected. You can break into the program anywhere and make all the changes you want. Add color and sound—even speech synthesis. Build the vocabulary. Personalize the program. It's also a good piece of work for beginning programmers to study.

Artificial Intelligence Research Group
921 North La Jolla Avenue
Los Angeles, CA 90046
$45

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Zenji

Zenji is a truly challenging maze game that combines the flavor of several Oriental board games with a two-dimensional version of the familiar rotating puzzle cube.

When the Zenji mazes first appear, they are disorganized and randomly oriented. Moving a disembodied Mandarin-style head (naturally), you must connect all the maze elements to the mysterious radiant *source*. When you reach a module that you wish to connect, position yourself in its exact center. Pressing the fire button and simultaneously moving the joystick left or right rotates the maze element—hopefully into contact with a section that's already connected to the *source*. You'll soon know if you've been successful, since the powerful green emanations from the *source* quickly flood any contiguous segments.

As you zoom around tying the maze together, you sometimes have the chance to pick up extra points. Don't slow down too much in quest of these ephemeral bonuses; you only have a short time to connect the maze. You're reminded of this not only by a screen timer, but also by an ominous increase in the tempo of the suitably atmospheric music.

In the midst of all this action, you have to figure out *how* to connect the maze. When you complete one, another maze—larger and more complex—appears. Your score is growing, but so are your problems. Eventually, in the larger mazes, you're avidly pursued by the Flames of Desire and some rapidly moving Sparks. If these touch you, you'll lose your head (and you only have four to play with). Your only defense against these foes is to spin the module you're in. Thus, while the object is connection, the defense is disconnection. Perhaps *Zenji* is really an exercise in Eastern philosophy. Precision and patience play as great a part as strategy and swiftness.

Although final understanding of the *source* remains elusive, *Zenji* is an undeniably enjoyable game. Making progress is easy on the lesser levels. As you move into those realms where the *source* reveals more of itself, you'll find great challenges and perhaps ultimate peace-of-mind.

Zenji appears to be a multiplayer game, offering its mysteries to up to eight acolytes at a time. It also takes joysticks in both ports when set up for more than one player. There's no documentation concerning this, however.

Activision, Inc.
Drawer 7286
Mountain View, CA 94039
$31.95 (disk)
$34.95 (cartridge)

VIP Terminal

VIP Terminal is a full-featured terminal program with such "extras" as 80-column display and support for up- and downloading. It uses a simple menu format to allow access to practically every possible communication configuration.

It would be difficult to find a communication situation that can't be handled with *VIP Terminal*. It supports nine different baud rates, programmable keys, three upload and download protocols, and autodialing for the 1650 Automodem. There's a built-in clock, a full screen editor, and many features which

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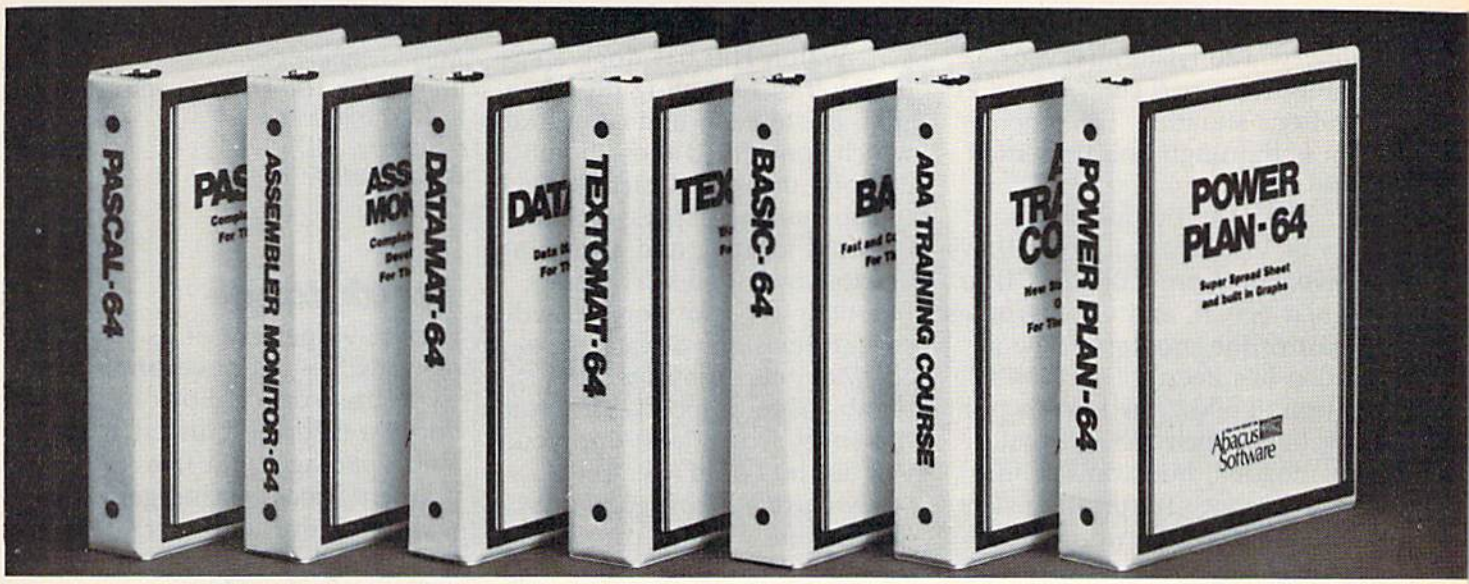

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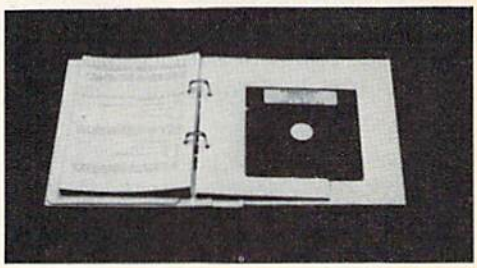

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allow you to customize your system for a particular communications situation. Documentation is thorough and presented very well.

The recently updated version of *VIP Terminal* now allows conversion from CBM ASCII to regular ASCII, and vice versa, as a part of the program. Also included has been a List Disk File feature to allow the user to print disk files which were virtually downloaded, but won't fit into the workspace for printing. The program will now work with the new Mitey Mo modem and the HES II modem as well as all other modems on the market.

In short, *VIP Terminal* is designed to give you maximum communications flexibility in an easy-to-use format. Written entirely in machine language, *VIP Terminal* is certainly worth consideration, especially if you use your computer for communication with many different systems.

Softlaw Corporation
132 Aero Camino
Goleta, CA 93117
$59.95 (disk)

London Blitz

This is one of the more exciting and exacting computer games for the 64 to come along in a while. Spend an hour playing *London Blitz*, and you'll be hooked.

During World War II, the German Luftwaffe continually peppered England with bombs, many of which sat for hours, days, and even weeks before detonating. Members of the military bomb squads who were sent to disarm those unexploded bombs faced some of the most dangerous, sensitive, and complicated situations possible.

Avalon Hill has done a superb job of recreating the tension, excitement, and complexity which confronted these bomb disposal units. You race through the streets and expressways of London, locating and disarming unexploded bombs. There are five basic types of bombs, with several revisions of each type. A citywide map shows where bombs have dropped. Switch to the street screen, and find your way to the bomb site. Once you've arrived, you go about the delicate work of correctly decoding the bomb's numeric combination with the aid of an onscreen voltage tester. Virtually all of the action is controlled by joystick.

The tension quickly builds. As you begin working on a bomb, a timer beeps the remaining minutes and seconds available before explosion. You'll hear the shrill whistle of other incoming bombs which you must reach and disarm before they go off. The codes you must break for the first two types of bombs are not terribly difficult, but there are different sensitivities. If you rush, you're likely to end up in a cloud of smoke. Bomb types III, IV, and V get progressively more complex and sensitive.

You work your way from Lance Corporal through four other ranks to Second Lieutenant. A status screen shows your rank, a summary of the bombs dropped and disarmed, and your commanding officer's remarks about your competence. Take the time to thoroughly read the pages of documentation as the manufacturer suggests. You'll find *London Blitz* to be one of the most absorbing computer games in your collection.

Microcomputer Games
The Avalon Hill Game Company
4517 Harford Road
Baltimore, MD 21214
$20 (cassette)
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Using the computer's joystick, you'll soon be moonwalking, floor rocking, headspinning, popping, and floor flipping. The first game is a dance contest in which your onscreen character must mimic the moves of the neighborhood's hottest breaker. Game two pits you against an entire "rocket crew" of break dancers. Mimic their moves or you'll end up being danced off a dock and into the river. The third game is an even more strenuous exercise in matching the four-, six-, or eight-move routines of a computer controlled dancer.

One of the most enjoyable of the games is the fourth option, in which you choreograph your own dance. Choose from a menu of dance moves, change the speed of your dancer, and select from five different musical numbers. Finally, in the fifth game, you can put it all together in the Grand Loop as you go through all four games.

Epyx has put together a nice package of breakdancing scenarios with colorful, smoothly moving graphics, and lively music.

Epyx, Inc.
1043 Kiel Court
Sunnyvale, CA 94089
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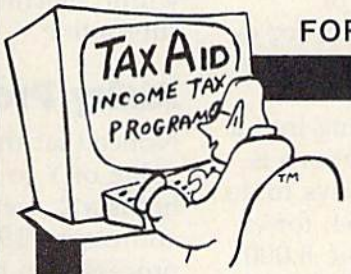

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MACHINE LANGUAGE FOR BEGINNERS

Richard Mansfield, Senior Editor

Self-Modifying Programs

This topic isn't strictly for beginners. Self-modification is a rather sophisticated way to supercharge your programs, but beginners should be able to follow the ideas. In addition, we'll cover some associated topics such as how addresses are stored in ML, and present a useful fill routine which can be used in a variety of applications. The accompanying program, for example, will clear the high-resolution screen on the Commodore 64.

A subroutine which stores something into a large number of adjoining memory locations is called a *fill routine*. There are several ways to do it. To clear the high-res screen on the 64, for example, we'll want to stuff zeroes into the 8,000 bytes from address 8192 to 16191 (we'll assume that this is where your high-res screen is currently located).

One way to fill it would be to simply set up a series of STA instructions, each one using the ,Y addressing mode so that 256 bytes are filled at one time. We can fill, for example, a 512-byte large block of memory by this method:

```
        LDA #0
        LDY #0
LOOP    STA 8192,Y
        STA 8448,Y
        INY
        BNE LOOP
        RTS
```

Here we are putting a zero (the thing we're going to store in the bytes of memory during our fill) into the Accumulator and also setting the Y register to zero so it can act as a 256-event counter. The first time we go through the loop, a zero is stored into addresses 8192 and 8448. Then we raise the Y register by 1 with INY and BNE (branch back if Y does not yet equal zero) to the LOOP again. Y will continue to count up until it goes past 255 and then resets itself to zero. At this point, we'll fall through the BNE and RTS back into BASIC or back to the JSR within machine language that called upon this subroutine.

Risky Practices

Notice that the ,Y addressing mode *adds* the value of Y to the number. For example, when Y holds a 2, we'll be storing (STA) a zero into addresses 8194 (8192 + 2) and 8450. By this process, two blocks of 256 bytes are filled with zero.

However, to clear the high-res screen, we've got to fill 8,000 bytes and that would mean using the STA ?,Y (the ? means whatever address is appropriate) 32 times. There's an easier, faster way to fill large areas, but it's somewhat subversive. It's frowned upon in some programming circles. It's called *self-modifying code*, and many teachers and books warn you against using it.

Let's risk it, though, since it's a good way to achieve ultra-high-speed results in some programming situations. Essentially, we're going to dynamically change part of our ML program while it's running. We're only going to use STA ?,Y once instead of 32 times, and we're going to keep punching in new numbers which raise the address by 256.

Here's what it looks like in a complete program that will clear out the entire high-res screen of the 64:

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Clear The High-Res Screen

```
150 ------------------------------------------------
160 ADDR/OPCODE/ADDR/LABEL/ MNEM  /ADDR/   COMMENTS
170 ------------------
180  864  169  32            LDA #32   SET UP THE PROPER STARTING ADDRESS
190  866  141  110 3         STA LOOP+2
200  869  169  0             LDA #0
210  871  141  109 3         STA LOOP+1
220  874  160  0             LDY #0
230 -------------------  MAIN LOOP
240  876  153  0 0 LOOP      STA 0000,Y     ** THE DUMMY **
250  879  200                INY
260  880  208  250           BNE LOOP
270  882  238  110 3         INC LOOP+2   HERE'S THE TRICK (SELF-MODIFICATION)
280  885  174  110 3         LDX LOOP+2
290  888  224  63            CPX #63    ARE WE AT THE HIGH BYTE LIMIT
300  890  208  240           BNE LOOP   IF NOT, RETURN TO CONTINUE FILLING
310  892  160  64            LDY #64          FILL UP THE LAST FRAGMENT
320  894  153  255 62FINI      STA 16127,Y
330  897  136                DEY
340  898  208  250           BNE FINI
350  900  169  147           LDA #147
360  902  32  210 255        JSR 65490  PRINT THE CLEAR-TEXT-SCREEN CHARACTER
370  905  96                 RTS
```

There's a lot of information packed into this kind of ML program listing. Before explaining the program, let's first explain the various zones of such listings.

What Each Column Means

On the far left, you'll see line numbers from 150–370. These are used just like BASIC line numbers. (Notice line 160. It's inserted to help show the definitions of the various columns in this listing.)

The first column is called ADDR and is the address in the computer's memory where these various ML instructions are stored. Follow along line 180 to see what each of these columns means. Here we see 864. That's the starting address of this subroutine. A two-byte long ML instruction (LDA #32) will be placed into addresses 864 and 865.

The next column is the opcode (operation-code). In this case it's 169, which is the number that the computer recognizes as the LDA # command. The third field is another kind of address. It's the address upon which the LDA # will act. In this case, it loads the number 32 into the Accumulator (this kind of addressing is called *immediate addressing* because we're not loading from the computer's 32nd memory location; rather, the actual number 32 is being placed into the Accumulator).

What we've looked at is a representation of two of the bytes that will be in the computer's memory after this program is assembled: 169 32 will sit in addresses 864 and 865. The next field is called the LABEL field, but line 180 has no label. (The only labels in this program are LOOP and FINI which are used as place markers to identify the start of the two loops in the program.)

ML Commands

The next zone is called MNEM for *mnemonic*. Mnemonics are the three-letter commands which are used when programming in ML. STA, for example, stands for STore the Accumulator; INY stands for INcrement the Y register. Mnemonics are the ML equivalent of BASIC commands.

Following the mnemonics are the addresses upon which these commands act: to store, to load from, to branch to, etc. In line 180, we are loading the accumulator with the number 32. Finally, there are sometimes comments to remind us what is going on in a particular line.

The first part of this fill routine puts the number 32 into address 878 (lines 180–190) and then puts a zero into address 877 (lines 200–210). How do we figure out these numbers?

In ML, addresses are computed a special way. Most addresses are held in two bytes. You calculate an address by dividing the address by 256, putting the result into the *higher byte in memory* and putting the remainder into the lower byte. So, to calculate the ML form of the address 8192 (the first byte of the high-res screen), we divide 8192/256 and get 32. That's called the *high byte* of our address and we store it into the high byte of the two bytes following LOOP. There is no remainder, so we put a zero into LOOP+1. Now the STA 0000,Y in line 240 has been transformed into STA 8192,Y.

Why not just write STA 8192,Y at line 240 and be done with it? We'll get to that in a minute.

Stuffing The Dummy

Now we're at the main loop of the program. The address bytes in line 240 are dummy bytes. We're going to be constantly changing them during the program run. However, the first time we come here when the program is started, we've just stored the ML address 8192 into the two bytes following the STA and so a zero (left in the accumulator after line 200) will be sent to address 8192. We've blanked out the first byte in the high-res screen. Only 7999 bytes to go.

Now we raise the Y register from zero to 1 and branch back to LOOP. Y is always added to the address in the STA ?,Y addressing mode, so this time we'll store the zero in the Accumulator into address 8192+1. And so forth until Y has gone past 255 and reset itself to zero. Then we fall through to line 270. (We've just filled up the first 256 bytes of the high-res screen.)

Line 270 is where the high byte of our STA address (line 240) will be raised by 1. When you raise the high byte of an ML address by 1, you are raising the actual address by 256.

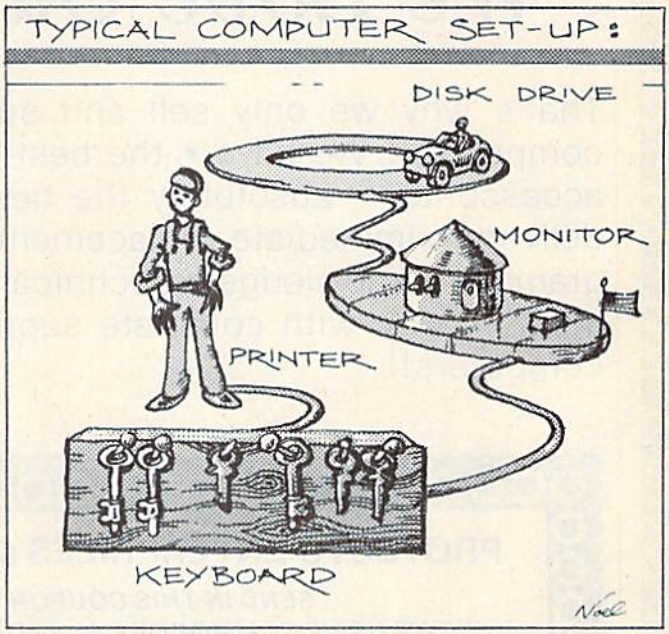
We're now going to test this high byte to see if we're through filling the screen. Line 280 fetches the high byte into the X register and we compare it against the number 63. We want to raise the address 31 times. We're looking for a 63 because we started out with a 32 in the high byte: (63 − 32 = 31).

If we haven't yet incremented the high byte up to 63, we branch back to the LOOP and fill another 256 bytes. If we have reached 63, we fall through to line 310 where we load the Y register with 64 and count down (DEY) through this little loop to take care of the last 64 bytes which were not filled by our main loop. These 64 bytes were left over after we filled 256 byte blocks 31 times. (There are 8000 bytes in a high-res screen and 256 * 31 = 7936 so we have a few more bytes to fill.)

Safety First

Finally, line 350 will load in the Commodore "clear-text-screen" character and we JSR to address 65490, which clears the text screen and gets rid of any residual garbage left after the high-res screen was cleared.

Now, why did we have to start this whole routine off by inserting the 8192 into the dummy address at line 240? If we didn't, we could only use the routine once. After the dummy has been incremented, if we didn't fix it at the start of the subroutine, the next time you JSR'd to this subroutine you would be storing above the high-res screen because the dummy would be left pointing to address 16128. This is one of the reasons why self-modifying code is considered risky. It's worth remembering to initialize your dummy if you use self-modifying addresses in your programs.



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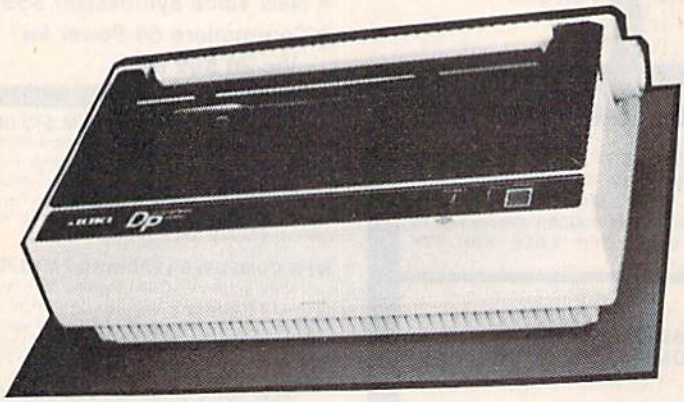

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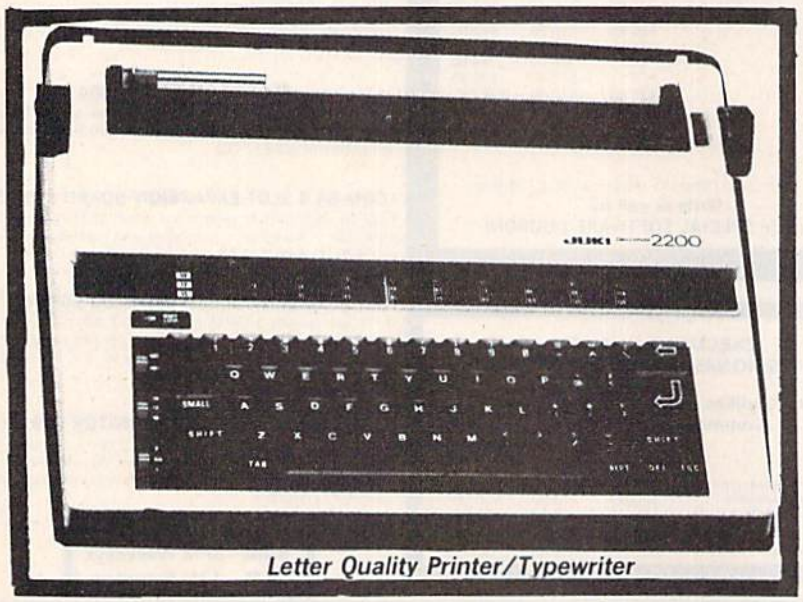

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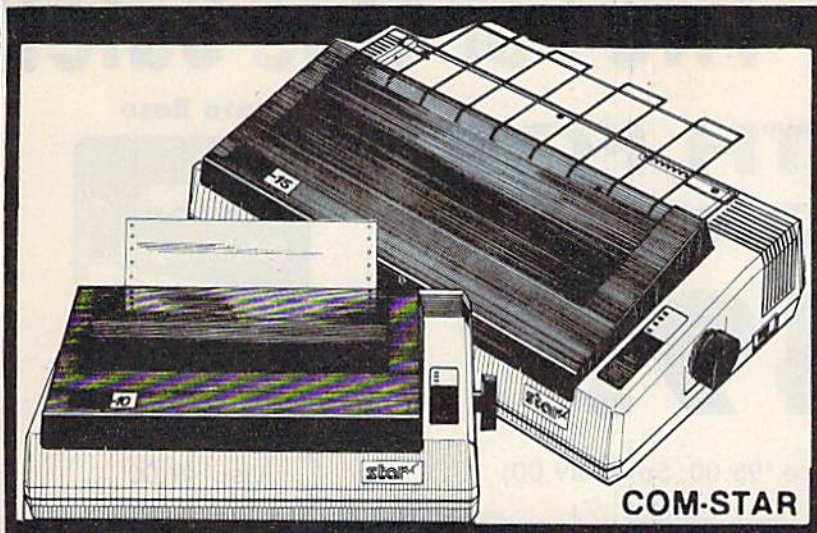

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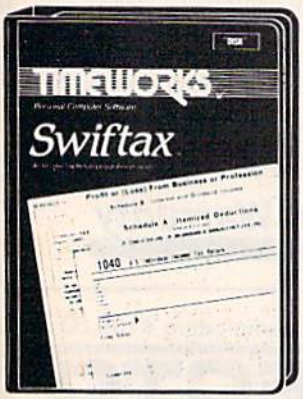

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Color Swap

Lee Noel, Jr., Assistant Editor

Frustrated by the time and trouble involved in making color changes to high-res program displays? "Color Swap" makes them instantly; and it works for the other graphics modes of your computer, too. For the VIC (with or without expansion) and 64.

"Color Swap" is a machine language graphics aid for your BASIC programs. Operating at high speed, it enables you to change colors at will—without LISTing and editing your program, and without waiting for the screen to rebuild. It works with any type of display—text, high-res, multicolor, sprites, and so on—and automatically adjusts itself to the screen configuration you've chosen.

To start, type in the appropriate version for your computer, Program 1 for the 64, or Program 2 for the VIC-20. Be sure to save a copy of the program before running it.

Next, run the program. If you have a correct version, you'll see a message with program instructions. If this is the first time you've used a machine language program, the SYS command in the final screen message may be unfamiliar to you. SYS XXXXX, a BASIC command that can be used in either direct or program mode, transfers control from the BASIC environment to the machine language program at address XXXXX.

Note where it tells you to SYS, then type NEW and press RETURN. Although you just erased the program from BASIC memory, it resides in a safe location (see below for details). You can load, save, and NEW lots of programs, but Color Swap remains ready to be activated at any time by the SYS call. The program can only be erased by turning off your computer, or by putting something else into its memory area.

A Pair Of POKEs

Once in place, the program is simple to use. It creates two new (pseudo) registers at addresses 700 and 701. Think of 700 as the Old Color Register, and 701 as the New Color Register. If you POKE these locations with two differing color codes and SYS to Color Swap, any displayed color that matches the value in 700 is changed to the color indicated at 701.

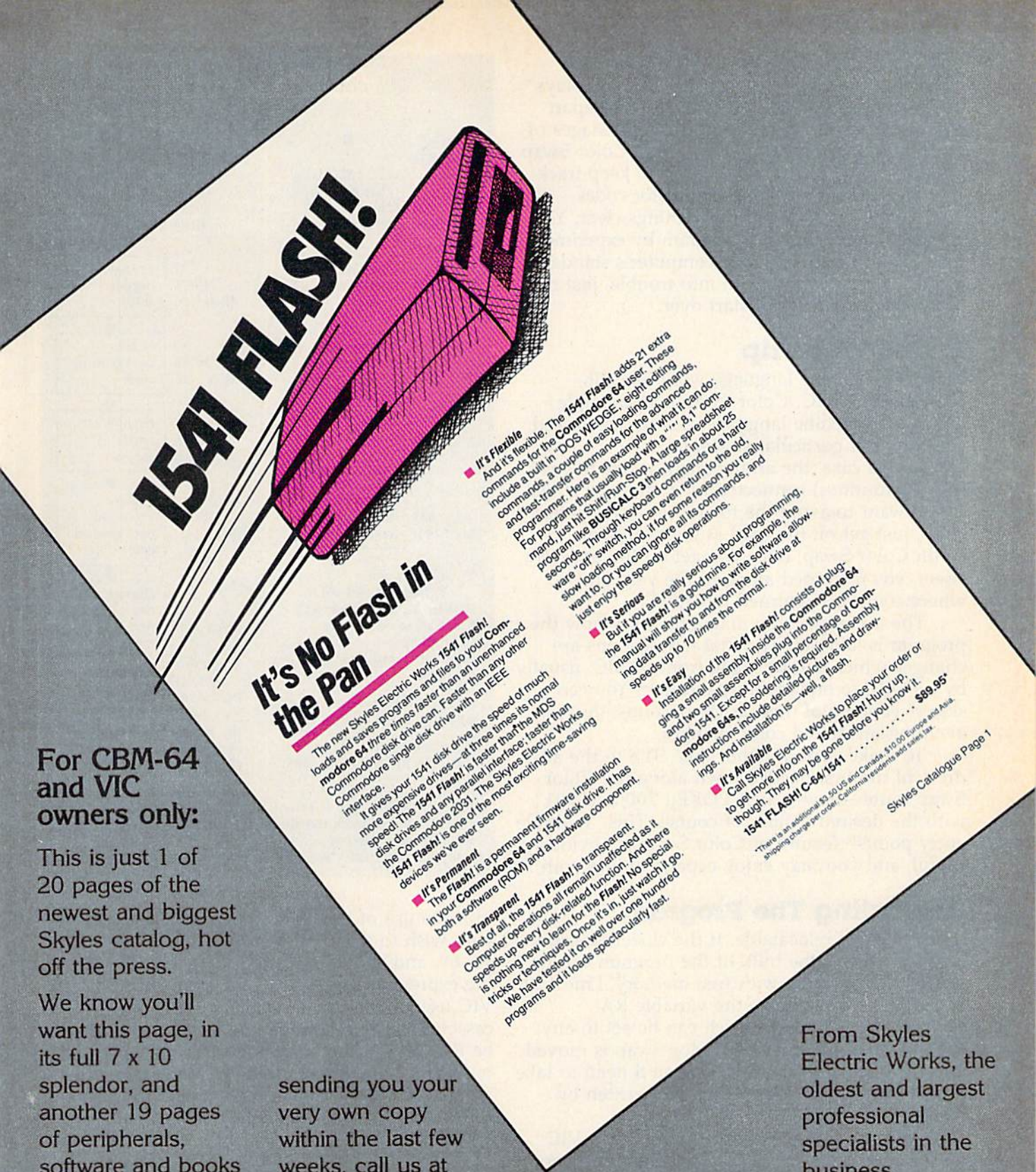
To make this clearer, here's an example. After loading and running Color Swap, load the program you want to experiment with, and bring up the desired screen display. Working in direct mode, you might enter

POKE700,6:POKE701,7:SYS XXXXX (where XXXXX is the Color Swap address)

If you enter this line and press RETURN, the program will find your display, look for blue (color code 6), and alter any it finds to yellow (code 7). This could, for example, change an entire blue sky to yellow, or cause the same transformation in a tiny redefined character. And the exchange of color takes place immediately—there's no waiting. If you don't like the effect, reverse the codes and SYS to Color Swap again.

As you go, make notes of the color codes that give the best results. Later on, you'll want to plug these tested values into the program you're working with. Color Swap acts directly on your computer, *not* on your programs; so you'll need either notes or a perfect memory.

Until you become thoroughly familiar with Color Swap, there are a number of points to keep in mind. The program is designed to change *every* occurrence of a particular color. This can be disconcerting at times. If you alter a blue sky and the current text color is also blue, both will be changed accordingly. (For a way around this problem, read on.) Moreover, it can be difficult to use Color Swap with multicolor mode on the VIC and with extended background color on the 64. The program works fine, but these display modes require that you know exactly what you're doing. Finally, for safety, stick to the standard Commodore color code numbers, 0–15. Note that Color Swap will not generally work in conjunction with other machine language programs, including utility cartridges like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the Super Expanders and BASIC extensions.

Color Swap is most effective with displays and programs that are fairly satisfactory apart from their colors. If you're in the early stages of developing a program and are using Color Swap concurrently, extra care is needed to keep track of which program is supplying color codes.

A little practice will make things clear. You can even start without a program by experimenting with the colors of your computer's standard display. If you ever do run into trouble, just reload your program and start over.

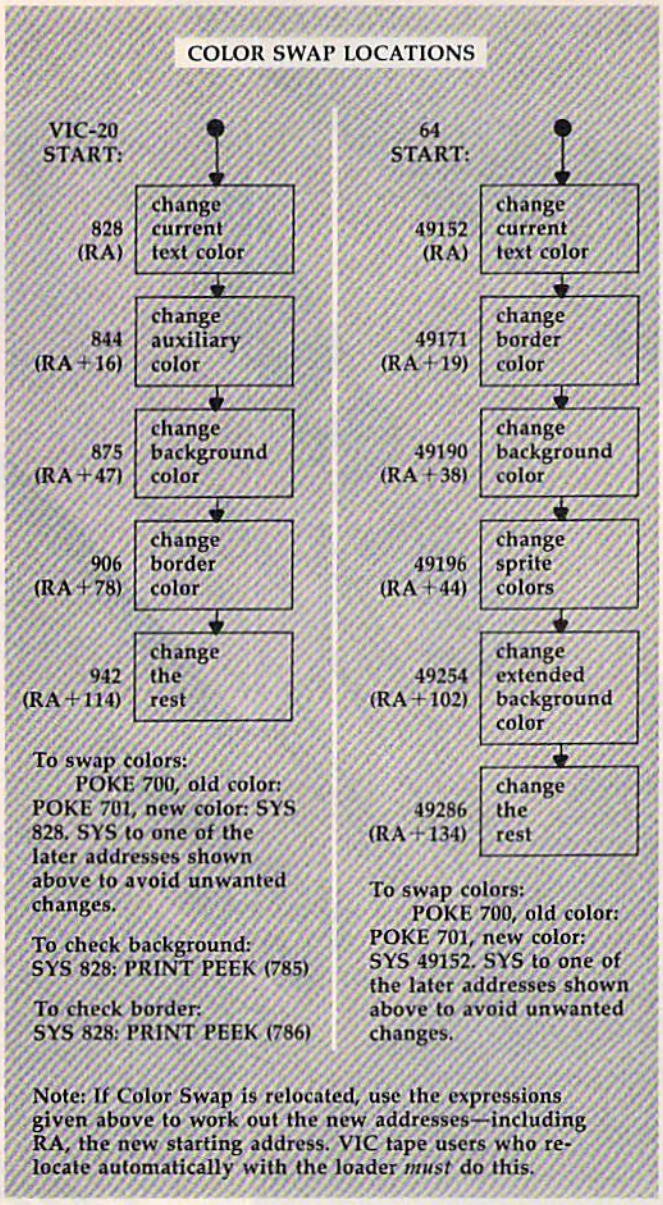
A One-Way Trip

Blocks of machine language work like subroutines in BASIC. Color Swap is just simple chunks of machine language subroutines linked together in a particular sequence.

In this case, the arrangement is like towns (the subroutines) connected by a one-way street. If you want to avoid the town that changes text color, just get on the road at the next town. (With Color Swap, once you get on the one-way street, you're carried along to the very end—where control is returned to BASIC.)

The accompanying diagrams show how the program is laid out. The first few sections are changes which can be made from BASIC, usually by a POKE to one memory location. You can skip over some of these early portions, thus avoiding unwanted color changes.

To make such a detour, just SYS to the address of the first needed town along the Color Swap route—having first POKEd 700 and 701 with the desired values, of course. This "multiple entry points" feature of Color Swap is obviously useful, and you may enjoy experimenting with it.


COLOR SWAP LOCATIONS
VIC-20 START:
828 (RA)
change current text color
844 (RA+16)
change auxiliary color
875 (RA+47)
change background color
906 (RA+78)
change border color
942 (RA+114)
change the rest
To swap colors: POKE 700, old color: POKE 701, new color: SYS 828. SYS to one of the later addresses shown above to avoid unwanted changes.
To check background: SYS 828: PRINT PEEK (785)
To check border: SYS 828: PRINT PEEK (786)
64 START:
49152 (RA)
change current text color
49171 (RA+19)
change border color
49190 (RA+38)
change background color
49196 (RA+44)
change sprite colors
49254 (RA+102)
change extended background color
49286 (RA+134)
change the rest
To swap colors: POKE 700, old color: POKE 701, new color: SYS 49152. SYS to one of the later addresses shown above to avoid unwanted changes.
Note: If Color Swap is relocated, use the expressions given above to work out the new addresses—including RA, the new starting address. VIC tape users who relocate automatically with the loader *must* do this.

Relocating The Program

Color Swap is relocatable. If the current location is inconvenient, the bulk of the program can be shifted to anywhere with free memory. Line 120 of the program contains the variable RA (Relocatable Address), which can be set to any desired value. However, if Color Swap is moved into the normal program area, you'll need to take steps to prevent it from being overwritten by BASIC.

Since the VIC has limited memory, a VIC user is given the option of placing Color Swap in the cassette buffer (locations 828–1019). Machine language programs placed in this buffer are protected from BASIC, but will be disrupted by cassette operations. So, to help VIC cassette users, the VIC version can perform a relocation, automatically placing and protecting Color Swap at the top of whatever memory configuration you have. VIC users have only to follow the prompts to make use of this option. (Those VIC users who wish to set RA themselves can delete lines 10–60, and should put their value for RA into the expression RA=RA at the start of line 120.) VIC users with disk drives may wish to select the cassette option when loading Color Swap. It will be POKEd into high memory, freeing the cassette buffer for other short machine language routines.

(Note: Color Swap works fine with the Super Expander *if none of the* Expander's *special commands are used.)*

Remember that in any relocation the target addresses of all the SYS calls have to be changed as well. The parenthetical expressions in the diagram show you how to do this. (RA is the value of the number that appears after SYS in the final message from your loader.) VIC tape users must make these calculations to employ the various entry points for Color Swap. If you move RA outside the values described above, make

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provisions to protect the program.

Color Swap also offers VIC users a special convenience: separate background and border color registers. Ordinarily, VIC background and border colors are combined into one number in the register at 36879, and with certain displays, it can be difficult to tell what colors you're looking at. Now, a SYS to the start of Color Swap puts the color code for the background into address 785 and the code for the border into 786. These locations may then be PEEKed, returning the values at the time of the SYS call.

A Special Case For VIC Programmers

Color Swap operates in such a simple way that it couldn't be extended to cover the reverse video mode on the VIC. However, for those programmers who use this single bit of memory, Program 3, VIC Inverter, is included. This program toggles the reverse bit from one value to the other each time you SYS 743.

Like Color Swap, this program can also be relocated by changing RA in the loader, although this will probably not be necessary: The Inverter is entirely independent of Color Swap, is safe from BASIC, and is not in the cassette buffer.

Extending Its Usefulness

After a little experimentation with Color Swap, you'll find many uses for it. Although it was devised mainly as a direct mode method of editing displayed colors, it can be extended to many other applications.

For example, 64 users know that they can't POKE character codes directly to screen memory and see any effect unless they make corresponding POKEs to color memory. As long as you know what code is in color memory, you can easily change it to contrast with the background by a SYS to Color Swap. With Color Swap in your 64 and the default display on screen, enter this in direct mode:

```
POKE700,6:POKE701,1:SYS49286:POKE1524,83
```

You should see a white heart appear near the center of your screen. POKE a few more character codes directly to screen memory. Convenient, isn't it?

Color Swap can also be added to programs as a subroutine. Although this may take a little thought, it can be worthwhile. As part of a larger program, Color Swap's speed enables it to flash windows of text and background on and off, make displays appear and disappear, and alter characters and sprites instantly.

See program listings on page 140.

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Debugging BASIC: Part 2

Todd Heimarck, Assistant Editor

The first version of a program almost always contains a few errors. You have to find and eliminate the bothersome bugs before you can really finish the program. Last month, we looked at some mistakes programmers can make. This month we'll consider some built-in flaws (how a computer can do things wrong) and look at some useful debugging methods.

In Part 1, we covered some of the limits which affect memory and the stack on the VIC and 64. Variables, too, have limits. They can lead to a variety of problems.

You can employ three types of variables in a program: string, floating point, and integer. Certain restrictions apply to each of the three.

Precision, Accuracy, Magnitude

Floating point (FP) numbers, so called because the decimal point can "float" to either end of the number, use up five bytes of memory. The variable name needs two additional bytes, so an FP variable fits into seven bytes of memory.

Three limits apply to floating point numbers: precision, accuracy, and magnitude.

Floating point numbers are allowed up to nine digits of precision. Go beyond nine and your computer automatically rounds to the nearest nine-digit number. The following program illustrates the limits of precision:

```
10 A$="1":B$=A$
20 FOR J=1TO20
30 A$=A$+B$: PRINTA$,VAL(A$)
40 NEXT
```

Note that we're working with strings, which can be longer than nine characters. But in line 30, the strings are converted to a VALue, which succumbs to the nine-digit limit. After the loop runs nine times, we see the letter E, which represents exponentiation (for example, ten to the power of X). We've hit one of the limits. You can make calculations on large numbers, but they will be rounded to the nearest nine digits of significance.

Another limit, accuracy, sounds like it might be the same as precision, but it's not. Limits on accuracy are built into almost any numbering system.

Computers calculate in binary (base two). Fractions which can be expressed as a combination of halves, fourths, eighths, sixteenths, etc. are accurate. Others have to be rounded to the nearest binary value.

People do the same thing with decimal fractions. The number 1/3 is translated to a never-ending series of threes, .3333333 (and so on).

The limits on accuracy can sometimes lead to errors of rounding. Try the following program:

```
10 X=.1
20 FORJ=0TO50:Y=Y+X:PRINTY:NEXT
```

A couple dozen times through the loop and the answers start to vary from what they should be. The number in computer memory is just about one tenth, but is a little off. It's only an approximation. As the numbers add up, so does the slight inaccuracy.

Magnitude is the final limit. It's the culprit in OVERFLOW errors. The Commodore operating system stores floating point numbers in five bytes. What happens when all of the bytes fill up? The number is a little beyond ten to the 38th power, a one followed by 38 zeros. A VIC or 64 cannot count any higher.

You can force an OVERFLOW error with this program:

```
10 X=10: FORJ=1TO50: PRINTJ,X: X=X*10: NE
   XT
```

The program stops when the computer reaches a number beyond which it cannot count. Change X=10 to X=−10 to find the limit on the negative side.

How do these limits affect BASIC programs? Precision is not really a problem, unless you want to count past a billion. If you sacrifice precision, you can count a little beyond a billion billion billion billion before reaching the highest number allowed. Accuracy can adversely affect a lot of programs, however. In a financial program, for example, you might add and subtract some numbers, ending up with a number like $ 517.120001 or $ 517.119999 instead of

$ 517.12. Such programs should include a rounding function, DEFFNR(X) = INT(X*100+.5)/100 to strip off those extra numbers.

Integer Limits

Integer variables have their own limits. Integer variables are always whole numbers and are signified in programs by a percent-sign (%) suffix. A%, B%, and Y8% are some examples. You can also use them in arrays—A5%(6), YZ%(15), P%(0), etc.

Magnitude, rarely a problem with FP numbers, can be a serious limit on integers. Integers are stored in only two bytes. The highest integer allowed is 32767, the lowest −32768.

Accuracy is never a problem with integers and the limits of precision never become a problem, either.

String Limits

Strings, collections of characters, are subject to only two limits, both related to length.

First, when INPUT, a string cannot exceed 80 characters on a 64 (two screen lines worth), 88 characters (four screen lines) on a VIC. Second, strings cannot be more than 255 characters long. Concatenation (or adding together two strings) allows strings to exceed the input limit. This program demonstrates:

```
10 A$="Z"
20 FORJ=1TO400: B$=B$+A$: PRINTJ,B$: NEXT
```

The string variable B$ is not initialized and so begins as a *null string* (a string containing nothing) with a length of zero. Each trip through the loop adds the variable A$, which holds the single letter Z. As B$ grows larger and larger, it reaches the limit of 255 characters, and the computer prints an error message.

File Errors

Sequential disk files operate much the same as tape files. You begin with the first item and continue until you reach the last. Reading and writing these files can lead to a variety of errors, some subtle, others not so subtle.

There's one command for writing (PRINT#) and two for reading (INPUT# and GET#). (Note there is no space before the "number" sign.) These three BASIC keywords differ from the usual PRINT, INPUT, and GET. If you abbreviate, don't use ?# for PRINT#, it won't work. P SHIFT-R is the correct short form for PRINT#.

If you open a file for reading and try to write to it or vice versa, you'll get a NOT INPUT FILE or NOT OUTPUT FILE error. If your disk drive is not plugged into the serial port, or not turned on, the computer will tell you DEVICE NOT PRESENT. If you press play on a Datassette (to load a program), and leave it on play, then try to write a file, it will seem to work but the file isn't actually there. There's a sensor that can tell if a button is pressed, but it doesn't distinguish between play, play/record, or even fast forward or rewind. Writing a file while play (but not record) is pressed won't write anything.

You can close a file which is already closed, but you can't open a file which is already open. To be safe, you can precede an OPEN with a CLOSE. For example, CLOSE2: OPEN2,8,2, "filename,S,W" will make sure the file is closed before it is opened.

If you don't close a file before ending the program, you can run into big problems. A disk drive has its own microprocessor, which keeps track of open files. Open a file, write to it, and turn off your computer without closing the file; the result is a "poison" file, which can corrupt other files on the disk. Poison files are marked in the directory with an asterisk. You should never scratch a poison file, you have to use the validate command to get rid of it. Before you end a program, be certain to close all files.

String Too Long

A very common file error is STRING TOO LONG, mentioned above.

For strings in a file which are longer than 80/88 characters, you'll have to use GET# rather than INPUT#. GET# reads in characters one by one. INPUT# bites off a chunk at a time. In many cases, GET# is more reliable than INPUT#.

Another mistake you can make is writing a file of strings and then trying to read back numeric variables. For example, PRINT#1,A$ to write the file followed by INPUT#1,A when reading it.

Checking Variables

Now let's see how you can track down and eliminate program bugs.

When you type RUN, all variables are cleared. Variable values then build up as the program runs. If the program stops, the variables are still intact, but you lose them the moment you change a line, or add a new one. Even if you simply press RETURN over a line, making no changes, you'll lose all variable values, until the program is run again.

Let's imagine a program which stops in the middle and says ILLEGAL QUANTITY IN 300. The first thing to do is type LIST300. You might then see something like this:

```
300 FOR A = S TO E: READ B: POKE A,B: CK%
    = CK% + B: NEXT
```

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One of those variables holds an illegal quantity of some kind. Type PRINT B to discover the value of B. If it's larger than 255 or smaller than zero, B is the culprit. When you POKE a number into memory, it has to be between zero and 255. If B is 519, for example, the program would crash. In this case, the number is coming from a DATA statement. Maybe you left out a comma, or two lines got stuck together when you forgot to press RETURN after a line. Whatever the cause, you'll have to find the incorrect DATA statement.

Testing variables can help you find a good number of bugs, especially when you have duplicated variable names, like using the name J in two different sections of a program. But remember, as soon as you press RETURN over a line, all variables will be lost.

If you want to rerun a program and still preserve the current variable values, you can choose a line number (call it xxx) and type GOTOxxx, as long as you haven't pressed RETURN over a line. GOTO does not destroy variable values as RUN does.

Simplify And Isolate

The most elusive bugs are the ones which don't happen right away. Rather, they appear after the program has run 20 or 30 times, seemingly without flaw. Just when you thought it was all finished, the program crashes—or locks up.

You must simplify and isolate, find the one situation that causes the problems. If possible, try to duplicate the error. If you know what happens just before a crash, you're halfway to finding the bug.

Besides PRINT (to check variables), there are four BASIC commands which are great aids when you're hunting down an elusive bug: STOP, CONT, REM, and GET.

Perhaps you've narrowed it down to a certain FOR-NEXT loop. An important variable, K8, is somehow being changed. So you add a line PRINT K8:STOP and every time the program reaches that line it prints the value of K8 and stops.

If you want to continue, type CONT. These two commands work in tandem, one stopping the program, the other starting it up again. While the program is temporarily stopped, you can examine any other variables you want, using PRINT.

STOP Radar

STOP can also be used as a pointer. Start with a 100-line program with a bug (in this example, let's assume it's straightforward and doesn't use any subroutines). The first line is 10, the last 1000, in increments of 10. Put a STOP halfway through the program, just before line 500. Run it and it crashes, before it even reaches line 500. You now know the problem—or at least one of them—happens somewhere in the first half of the program. Now put a STOP in line 250. This time the program stops, but not because of an error. You type CONT (for CONTinue) and again the computer freezes before getting to 500. With just a couple of lines, you've zeroed in on the general area of the bug. It's after 250, but before 500. A couple more STOPs and you can narrow the possibilities to just a few lines. STOP is like radar used to pinpoint the bug.

Now you suspect the bug is in a certain line. But you don't know for sure. The line does some calculations followed by a POKE or two. You can make the line invisible with a REMark. REM is usually used to add comments, because it makes the computer ignore everything up to the next line. But it's also good for temporarily removing a line, so the line, as usual, is ignored.

Finally, GET can sometimes substitute for the STOP-CONT debugging duo. If you'd rather halt the program temporarily, instead of stopping it, add a line XXX GET G$:IF G$ =""THEN XXX. Whenever the line is executed, everything pauses until you press a key.

Time Out To Clean The Blackboard

Have you ever written a program which usually runs well but sometimes pauses before starting up again?

You don't have a bug. You can put the blame on a process called *garbage collection*, especially if the program contains a lot of string variables.

As variables are defined, they are put into memory just after the end of the program. But strings can contain one letter or five or 160.

Say your program has a variable A$ and you define it, A$ = "HELLO, " + N$ (where N$ is a person's name). You've created a *dynamic string*. Later on, the program changes A$ to "HELLO AGAIN, " + N$. One way to store this new string on the memory blackboard would be erase the old one and put this one in its place. But the new A$ is longer, so the computer would have to move a lot of memory around to make room. Instead, the computer marks the old variable as "garbage," drawing a line through it, and puts the new variable into an empty space.

But if memory fills up completely (from all the garbage strings), it's time to get rid of all the strings no longer being used. And that takes time. To illustrate, look at this program:

```
10 DIMA$(255)
20 FORX=1TO255: B=INT(RND(1)*26+65)
30 B$=CHR$(B): A$(X)=A$(X-1)+B$: PRINTB$
40 NEXT: GOTO20
```

Enter it and type RUN. It takes some time before available string memory fills with garbage. But eventually, you'll see the program pause while it frees up some space. There's nothing wrong with the computer, it's doing just what it's supposed to.

The process of garbage collection is another quirk of the operating system. Asking the computer how much free memory is left forces garbage collection. Add a line 25 F=FRE(0) to the program above, and all pauses are eliminated. (Actually there's a minuscule pause each time you ask for FRE(0), but it's not noticeable.)

Lockup Bugs

If your VIC or 64 locks up, consider the possibility that your computer is *not* locked up. A FOR-NEXT loop that counts to a million takes a lot of time. So does POKEing a few thousand numbers into memory. And it's possible to write an inefficient sorting routine that takes hours, even days, to complete. In cases like these, you might want to demonstrate that there's no lockup by printing to the screen or changing border color once in a while.

Hardware Errors

Hardware should be the last thing you blame. If something is not going right in a program, it's almost always the program's fault.

Hardware, especially moving parts as in a disk drive or printer, occasionally has problems. After many hours of use, disk drives can become misaligned; they'll read disks they've written to, but not disks formatted on other drives (commercial software for example). And the head on a cassette drive can become dirty or magnetized.

There's one operating system/hardware glitch you may run into if you use a VIC-20, Datassette, and 1526 printer (which is why the 1526's shipping box is labeled "For The 64 Only"). After a tape save, load, read, or write, the 1526 printer may be inaccessible. The computer, having just talked to the tape drive, doesn't want to open a line to the printer. SYS 64490 solves this problem, making the printer available again.

The Commodore 64 also has a bug in its operating system. Put the cursor at the bottom line of the screen, type more than 80 characters (hold the space bar down until it traverses more than two screen lines), and then try to delete back to the eightieth character. The program in memory runs and the keyboard locks up. If you own a Datassette, you can get out of the lockup by pressing the left SHIFT key and the number 3 at the same time. Then press the tape PLAY button, followed by RUN/STOP. The bug seems to occur only with certain character colors.

Two rare bugs you may encounter involve disk access. The first is a documented problem with relative files. If you read a short record from a file that begins on a sector boundary and then later read a subsequent file that is longer than the first and spans two sectors, the second read may be corrupted because a pointer is not updated. The solution is to set the record pointer before *and* after reading a file.

The second is undocumented; it's one of those full moon bugs. The disk SAVE WITH REPLACE option works almost as it should. It scratches the old program and saves a good version of the replacement program. But it may corrupt another file on the disk, especially if the disk is almost full. So far, it has not been proved without a doubt that on a 1541 SAVE WITH REPLACE (SAVE"@:filename") is flawed. In fact, there are two people who have offered a reward to the person who proves the bug exists.

Nevertheless hardware rarely causes problems, although sometimes a memory chip burns out or a soldered connection breaks. Generally, if your computer works for a day or two after you buy it, it will work for years.

MLX And Proofreader

The two GAZETTE typing aids, MLX and Automatic Proofreader, help immensely. But they can miss transposition errors.

Both programs work by adding up numbers. MLX, used for entering machine language programs, adds six numbers (plus the memory location). So you could type 000, 000, 000, 000, 013, 015 to get a total of 28. But 000, 000, 000, 000, 015, 013 also adds up to 28. MLX wouldn't know the difference. The checksum matches, but the numbers are wrong. Unfortunately, machine language is extremely sensitive to incorrect numbers and there could be big problems with the program.

BASIC is more forgiving than machine language—it usually tells you the type of error and the line number. The Proofreader is also forgiving. It adds up the ASCII values of the line and calculates the checksum. So if you type PRINT+AB, rather than PRINTA+B, the Proofreader checksum number will come out fine. PRITN is a small problem, because it causes a SYNTAX ERROR. But a POKE with transposed numbers can lead to trouble, 525 instead of 255, for example.

Line Number Cross Reference

Heinz Wrosch

This handy programmer's utility searches through a BASIC program for all GOTOs and GOSUBs, determining which lines call other lines. It can be useful when a program must be renumbered, or in debugging sessions. For the VIC (with or without expansion) and the 64. Also includes printer option.

Part of what makes computers so powerful is their decision-making ability. The BASIC commands GOSUB, GOTO, and IF-THEN—what could be called forks in the road—make the decisions. When the program reaches a fork, it changes directions.

There are times when you need to find the points where a decision is made. You can delete a REMark, for example, but there will be problems if another line tries to GOTO that line. Or if you're renumbering a subroutine, you'll need to find which parts of the program GOSUB to that subroutine.

Finding The Decision Points

If you own a printer, you can LIST the program and trace through it by hand, marking all branches and drawing arrows. But there's a simpler way.

"Line Number Cross Reference" does the tedious work for you. It's a machine language (ML) program that starts at the beginning of your program and prints out a complete list of where all the branches are. You choose whether the list goes to the screen or to a printer.

For example, if you type in the 64 version of Cross Reference, and use it on itself, your screen should look like this:

```
LINE NUMBER CROSS REFERENCE:
==========================

LINE          REFERENCED AT

 170          200
 180          140  160
 210          170

LISTING COMPLETE
```

It's a short list, because this program doesn't have to make a lot of decisions, all it does is POKE an ML program into memory. But such a list can be invaluable when you're tracing through a program, creating a flow chart, figuring out which part does what. Cross references are also useful when you need to renumber a program, or if you plan to delete a range of lines.

Entering The Program

There are two versions of Cross Reference, one for the 64, one for the VIC (with or without expansion). After typing in the appropriate version, make sure you save it to tape or disk.

When you type RUN, the ML program is POKEd into free memory. The 64 version goes into the safe area beginning at 49152. The VIC version goes at the top of BASIC memory, which varies according to how much expansion memory is in place. The VIC version lowers the top-of-memory pointer to protect the program from interference by BASIC, so you should not run it more than once. You'll lose about 500 bytes every time you run the VIC version.

An internal checksum is calculated, and if you've typed the DATA statements correctly, a message with two SYS numbers will appear on the screen:

```
SYS 49518   (64)
SYS 49515   (64—output to printer)
SYS 7570    (unexpanded VIC)
SYS 7567    (VIC—output to printer)
```

VIC owners with expansion in place will see another (higher) set of numbers.

You'll need to remember the ML entry point, so write down the numbers. Next, type NEW to erase the BASIC loader (do not type NEW unless you've already saved the program, or it will be lost). You can load the program you want to examine, and type the SYS to start Cross Reference.

It's helpful, if you have a printer, to first LIST the program to the printer, and then do the appropriate SYS. That way, the cross references

appear on the same sheet of paper as the program listing.

How It Works

To understand how such a utility works, it helps to know a little about how BASIC programs are stored in memory. When you type a program line, the BASIC keywords are tokenized (converted to a single number between 128 and 255).

In addition to tokenizing, the computer creates a line link and converts the line number to low-byte/high-byte format. In memory, a BASIC line looks like this:

```
( L )    line link low
( L )    link link high
( N )    line number low
( N )    line number high
(  )     BASIC line, with tokens
.....
(  )
(  )
( 0 )    zero, marking end of line
```

There are several ways to create a branch in BASIC (xxx represents the line number):

```
GOTO xxx
GOSUB xxx
IF... THEN xxx
IF... GOTO xxx
IF... THEN GOTO xxx
ON... GOTO xxx, xxx, xxx
ON... GOSUB xxx, xxx, xxx
```

In each case, the line number comes after a GOTO, GOSUB, or THEN. There may also be a space separating them. The program has to search for the tokens representing these three keywords, and look at the numbers following them.

Line Number Cross Reference begins with the first line number, and searches through program memory looking for a branch. If it finds the token for GOTO (137), GOSUB (141), or THEN (167), it analyzes the rest of the line for a match (to the first line). (Note that you must use GOTO, not GO TO. The VIC and 64 tokenize GO differently than GOTO.) After checking every line for references to the first program line, it searches (again through every line) for a match to the second line, the third, the fourth, and so on to the last line.

Note that it tries to match only existing line numbers. If your program contains a GOTO 200 and you delete line 200, it will not show up on the list of cross referenced lines, because line 200 no longer exists. Thus, you should run Cross Reference *before* renumbering or deleting lines.

See program listings on page 146.

WHATEVER HAPPENED TO FAY WRAY

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Baker's Dozen
Part 2

Lawrence Cotton

This month, we'll look at five interesting sound and graphics programs for the 64. Each is short and serves as a good example of what can be accomplished with just a few program lines.

Last month, we looked at four short programs that demonstrate the color and graphics capabilities of the 64. We'll continue in the same vein this month, but we'll look at two new programs which integrate sound with graphics, and three which demonstrate some unusual sound effects. By studying the programs, you may see some techniques which you can use in your own programs. If you're more of a user than a programmer, you'll still enjoy these unusual sight and sound demonstrations.

Music Patterns

This program performs differently every time you run it. Random-colored blocks fly around the screen, bouncing off borders, to the accompaniment of random tones. The result is interesting, sometimes even beautiful, visual and sound patterns. Occasionally, you may see and hear the patterns looping. If so, just press RUN/STOP and type RUN to start over. Give this one a few tries to see how interesting it can be. Let's look at the key lines in the program:

Line 1 clears the sound chip (0), turns up the volume (15), sets attack and decay to 4 (no sustain/release), and defines AA and BB as upper and lower frequency memory locations for voice 1.

Line 10 clears the screen (CHR$147), PRINTs in white (CHR$5), changes the screen and border color to black (53280,0 and 53281,0), sets the high pulse at eight, and defines CC (voice 1 turn on/off).

In line 20, C (unrelated to location 54272) represents the amount that must be added to screen memory to control a POKEd character's color. Note how C is added to K in lines 30, 100, 200, and 300.

Lines 20–28 generate random screen starting locations, number of characters generated (up to 11), frequencies H(1) through H(4) and L(1) through L(4), and character colors (omitting black and white); B represents a reversed space.

Lines 30, 100, 200, and 300 POKE the reversed spaces to the screen and turn the note (voice 65) on. K is incremented by adding +41, −41, +39, or −39.

Lines 40, 50, 110, 120, 210, 220, 310, and 320 check for screen borders and loop to the proper lines if a hit is detected.

Lines 60, 130, 230, and 330 turn the voice off and loop back to finish a series of blocks.

Finally, line 340 sends the program back to pick another number of characters generated, new frequencies, and colors.

Bleep

"Bleep" is similar to Music Patterns, except we generate a new character each time the program runs, and the patterns build from the center of the screen (location 1524). Let's look at the key lines.

Lines 111–127 pick characters from a predetermined set. Feel free to insert your own CHR$ values. Lines 200–210 pick random frequencies and colors, and lines 220–234 determine which direction the character will move.

Lines 300–310 check only the top and bottom of the screen, provide a short delay loop, and loop back (via line 360) to line 100. Lines 320–340 do all the POKEing—first frequencies, then characters and colors, then notes on and off after a short delay loop.

Line 350 loops back to pick a new frequency, color, and direction, but retains the same character.

Chimes

Unlike the previous programs, "Chimes" is strictly a sound demonstration of ring modulation. After running the program, you'll hear a repeated set of chime effects and see voice 1 and 2

frequency values. Press the space bar to hear another set of chime effects and see the corresponding values. The REMs in the listing should help explain what the program is doing, but a few comments are in order.

We assign random frequencies to voices 1 and 3 (lines 70 and 100, respectively), then combine them in line 120. Location 54276, which normally turns on waveforms (by POKEing 17 for triangle, 33 for sawtooth, 65 for pulse or square, and 129 for noise), can be POKEd with other quantities to produce various effects.

Tuba

Another sound-only program, "Tuba" plays a scale sounding, of course, like a tuba. It demonstrates the use of the 64's *resonant filter*, found at locations 54292–54296. After running the program, you are prompted to press a number from 0 (fast) to 500 (slow). This controls the speed at which the scale is played.

As in Chimes, the program listing contains several REMs which may be of assistance in understanding the program. Let's take a look at the key lines.

Line 40 controls the attack, decay, sustain, and release of the notes, and line 50 processes voice 1 through the filter.

Line 60 chooses which filter (see the REM), and line 75 lets you plug in variable D, the speed at which the tuba plays the scale.

Line 100 POKEs frequencies (from the data in line 160, read by line 90) into locations 54272 and 54273.

Line 120 turns the note on, and line 130 varies the cut-off frequency from 255 to 1 in steps of −10, adds a delay (D) to control the speed, then turns the note off.

Line 140 contains a suggestion (try others, too) in a REM statement, and line 160 contains musical note values from the 64 User's Manual. Feel free to experiment with these.

Good Vibes

The final program this month, "Good Vibes," is a test program you can use as an aid in creating various sounds for your own programs.

After running the program, a set of instructions appear. First, choose a voice (1–5). Press the space bar to play a random vibe over and over. Press any key (not the space bar) to hear a sound and list its values (low and high frequencies, and the step). You can also hold any key down to cycle through random sounds or press V to change to another voice.

Let's look at the key lines:

Lines 10–36 set up the sound chip, clear the screen, and remind you to turn up the volume.

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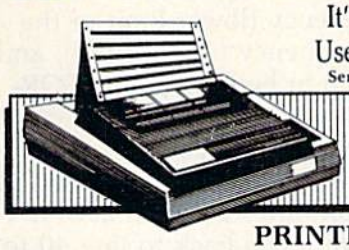

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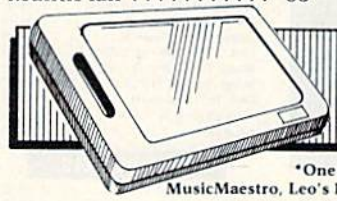

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Lines 40–120 POKE a waveform to location 54276 and clear the screen again.

Three random values are generated in line 130: C is the low frequency (lower limit of the vibe); D is the high frequency (upper limit); and E is the size of the step to be used in the FOR-NEXT loops.

Lines 200–220 check the keyboard to see which key is pressed. If the space bar is pressed, sound is generated from lines 280 and 290. If V is pressed, the program loops back to line 40 to get another voice.

Lines 230–240 POKE voice 1 memory locations with limits, stepped either slowly (values around upper limit E) or quickly (values around lower limit E), first up (line 230), then down (line 240).

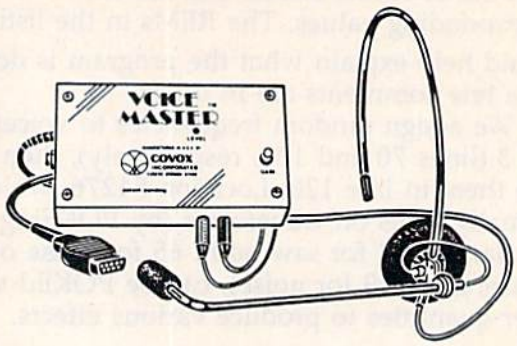
Line 250 PRINTs frequencies and steps to the screen, then turns the sound off by POKEing voice 1 locations with a zero.

You can write down or print out the frequencies and steps and use them in one of your own programs. A lot of wild sounds are possible.

Next month, we'll conclude our series with some interesting and colorful graphics programs. Until then, experiment with these sound programs. You may find that they can be a real aid in your own programming efforts.

See program listings on page 148.

THE AMAZING VOICE MASTER



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NEWS & PRODUCTS

The $399 Indus GT disk drive for the Commodore 64.

Disk Drive For Commodore Computers

A 5-1/4 inch disk drive designed to be 100 percent compatible with Commodore 64 and VIC-20 software has been introduced by Indus Systems, Inc. The Indus GT reportedly operates up to 400 percent faster than comparable drives. Features include readouts that display track location, drive number, and error codes; buttons to control digital readouts; and electronic write-protect. Indus also is supplying a free software package that includes a data base, spreadsheet, and word processor with each disk drive.

Suggested retail price is $399.

Indus Systems, Inc.
9304 Deering Avenue
Chatsworth, CA 91311
(818) 882-9600

64 Disk And Memory Utility

For intermediate and advanced programmers, Quantum Software has developed *Peek A Byte 64*. The program is a full-featured disk editor with built-in monitor and disassembler as part of the software. It not only displays HEX values, but also ASCII and Pet ASCII.

Peek A Byte 64 has a track/sector and computer memory display and editor with cursor control. HELP screens are available with a single keystroke. Commands are designed for simplicity. Keyboard errors and disk read/write errors are all reported, and the program does not lock-up the computer as do some sector editors.

The program resides in high memory, and is compatible with many BASIC programs and with the DOS Wedge 5.1. A tutorial manual is included.

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64 Drawing System

The *Versawriter Drawing Tablet*, a hardware and software package that plugs into the user port of the Commodore 64, and which allows entry of graphics to the 64's medium resolution screen, has been released by Versa Computing, Inc.

More than 30 graphics commands are available with the system, including full editing, microscope, textwriter, and color fill, in more than 200 color options. Graphics produced with the system can be saved to disk for printing later.

Suggested retail price is $149.

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NEWS&PRODUCTS

Cardco's MT/2 monitor tuner converts a computer monitor into a TV.

Monitor Tuner

Cardco has introduced a monitor tuner that converts a computer monitor into a television set. The tuner is compatible with both color and monochrome monitors, and includes an audio output to a monitor or stereo system, a computer/TV switch, and a cable/antenna input.

The MT/2 monitor tuner retails for $99.95.

Cardco, Inc.
300 South Topeka
Wichita, KS 67202
(316) 267-6525

Adventure, Strategy Games For 64

Strategic Simulations, Inc. has released several adventure and strategy games for the Commodore 64. New titles include:

Rails West!, a simulation of railroad development in the late 1800s; *Questron*, a fantasy role-playing game; *Broadsides*, a simulation of Napoleonic naval battles; *President Elect*, a game based on the presidential elections from 1960 to the present; *Computer Quarterback*, a football simulation; and *Breakthrough in the Ardennes*, a simulation of the last major German World War II offensive.

All of the games retail for $39.95 each, except *Breakthrough in the Ardennes*, which has a suggested retail price of $59.95.

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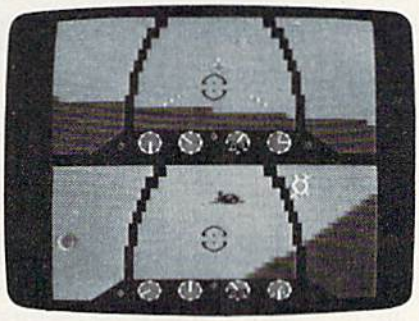
64 Flight Simulation Game

Mig Alley Ace, a two-player flight simulation game which features separate cockpits on the same screen and three-dimensional graphics, has been released for the Commodore 64 by MicroProse Software.

Simulation pilots can fly their F-86 Sabrejets in battle against each other, or can choose to dogfight cooperatively against a flight of MIG-15s, defending United Nations troops during the Korean conflict of the 1950s.



Double cockpits on the same screen are one of the features of Mig Alley Ace, *newly released for the Commodore 64 by MicroProse Software.*

Suggested retail price for *Mig Alley Ace*, on either disk or cassette, is $34.95.

MicroProse Software
10616 Beaver Dam Road
Hunt Valley, MD 21030
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How To Type In COMPUTE!'s GAZETTE Programs

Each month, COMPUTE!'s GAZETTE publishes programs for the VIC-20, Commodore 64, Plus 4, and 16. Each program is clearly marked by title and version. Be sure to type in the correct version for your machine. Also, carefully read the instructions in the corresponding article. This can save time and eliminate any questions which might arise after you begin typing.

We publish two programs, appearing in alternating months, designed to make your typing effort easier: The Automatic Proofreader, and MLX, designed for entering machine language programs.

When entering a BASIC program, be especially careful with DATA statements as they are extremely sensitive to errors. A mistyped number in a DATA statement can cause your machine to "lock up" (you'll have no control over the computer). If this happens, the only recourse is to turn your computer off then back on, erasing whatever was in memory. So be sure to *save a copy of your program before you run it*. If your computer crashes, you can always reload the program and look for the error.

Special Characters

Most of the programs listed in each issue contain special control characters. To facilitate typing in any programs from the GAZETTE, use the following listing conventions.

The most common type of control characters in our listings appear as words within braces: {DOWN} means to press the cursor down key; {5 spaces} means to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing another key), the character is underlined. For example, A means hold down the the SHIFT key and press A. You may see strange characters on your screen, but that's to be expected. If you find a number followed by an underlined key enclosed in braces (for example, {8 A}), type the key as many times as indicated (in our example, enter eight SHIFTed A's).

If a key is enclosed in special brackets, , hold down the Commodore key (at the lower left corner of the keyboard) and press the indicated character.

Rarely, you'll see a single letter of the alphabet enclosed in braces. This can be entered on the Commodore 64 by pressing the CTRL key while typing the letter in braces. For example, {A} means to press CTRL-A.

The Quote Mode

Although you can move the cursor around the screen with the CRSR keys, often a programmer will want to move the cursor under program control. This is seen in examples such as {LEFT}, and {HOME} in the program listings. The only way the computer can tell the difference between direct and programmed cursor control is *the quote mode*.

Once you press the quote key, you're in quote mode. This mode can be confusing if you mistype a character and cursor left to change it. You'll see a reverse video character (a graphics symbol for cursor left). In this case, you can use the DELete key to back up and edit the line. Type another quote and you're out of quote mode. If things really get confusing, you can exit quote mode simply by pressing RETURN. Then just cursor up to the mistyped line and fix it.

When You Read:	Press:	See:
{CLR}	SHIFT + CLR/HOME	
{HOME}	CLR/HOME	
{UP}	SHIFT + CRSR ↑	
{DOWN}	CRSR ↑	
{LEFT}	SHIFT + CRSR ←	
{RIGHT}	CRSR ←	
{RVS}	CTRL + 9	
{OFF}	CTRL + 0	
{BLK}	CTRL + 1	
{WHT}	CTRL + 2	
{RED}	CTRL + 3	
{CYN}	CTRL + 4	

When You Read:	Press:	See:
{PUR}	CTRL + 5	
{GRN}	CTRL + 6	
{BLU}	CTRL + 7	
{YEL}	CTRL + 8	
{F1}	f1	
{F2}	SHIFT + f1	
{F3}	f3	
{F4}	SHIFT + f3	
{F5}	f5	
{F6}	SHIFT + f5	
{F7}	f7	
{F8}	SHIFT + f7	

When You Read:	Press:	See:
←	←	
↑	SHIFT + ↑	

For Commodore 64 Only

When You Read:	Press:	See:
{1}	C= + 1	
{2}	C= + 2	
{3}	C= + 3	
{4}	C= + 4	
{5}	C= + 5	
{6}	C= + 6	
{7}	C= + 7	
{8}	C= + 8	

Bug-Swatter:
Modifications And Corrections

• There are no bugs in "C/G Term" (November 1984). However, there are some additions and corrections for "C/G Bulletin Board" (December and January).

First, the article did not clearly state that as system operator (sysop), your user ID is 1000. You should use this ID number when you do maintenance and updates on the board, but you can't create a user file with this number. Other users will have ID numbers ranging from 1001 to 1999.

If you tried typing the two MLX programs, you may have encountered an UNDEFINED STATEMENT error in line 550. The explanation of how to type in the program neglected to mention that you must first move the start of BASIC to avoid overwriting the beginning of MLX. Before loading MLX, enter this line:

```
POKE 642,70:SYS 58260
```

Once you've saved the program to disk, turn the computer off and back on and follow the instructions in the December issue for setting up the message disk.

Finally, there are two situations where callers may be able to crash the bulletin board. The first happens when someone calls and hangs up before connecting with the board. The second occurs when the user chooses to leave a message and then presses f8 (to get out of message mode). Version 1.0, which appeared on the December GAZETTE DISK and in the December and January issues, contains these glitches. Version 1.1, on the January DISK, has been corrected and should be free of bugs.

To fix version 1.0, follow these instructions:

1. Load and run MLX, enter a starting address of 49152, ending address 49493, then enter this patch program. When you're finished, save it to disk.

```
49152 :169,157,141,165,009,169,042
49158 :239,141,069,015,169,234,105
49164 :141,120,023,141,121,023,069
49170 :141,122,023,169,004,141,106
49176 :037,034,169,033,141,038,220
49182 :034,169,076,141,008,010,212
49188 :141,166,015,141,043,017,047
49194 :169,062,141,009,010,169,090
49200 :189,141,167,015,169,211,172
49206 :141,044,017,169,087,141,141
49212 :010,010,141,168,015,141,033
49218 :045,017,169,156,141,105,187
49224 :008,169,086,141,111,008,083
49230 :160,000,140,152,192,162,116
49236 :158,134,251,162,192,134,091
49242 :252,162,062,134,253,162,091
49248 :087,134,254,172,152,192,063
49254 :177,251,145,253,238,152,038
49260 :192,174,152,192,224,181,199
49266 :144,239,169,001,162,008,069
49272 :160,000,032,186,255,169,154
49278 :005,162,153,160,192,032,062
49284 :189,255,169,001,133,251,106
49290 :169,008,133,252,162,244,082
49296 :160,087,169,251,032,216,035
49302 :255,000,000,048,058,066,065
49308 :066,083,169,000,170,168,044
49314 :032,219,255,173,003,221,041
49320 :041,239,141,003,221,173,218
49326 :001,221,041,016,201,000,142
49332 :208,010,169,000,170,168,137
49338 :032,219,255,076,106,087,193
49344 :032,222,255,224,028,144,073
49350 :222,076,232,009,032,204,205
49356 :255,162,002,032,198,255,084
49362 :032,228,255,201,000,240,142
49368 :040,201,019,208,006,141,063
49374 :102,072,076,138,087,201,130
49380 :022,208,003,141,102,072,008
49386 :032,204,255,162,002,032,153
49392 :201,255,169,002,032,210,085
49398 :255,032,210,255,174,102,250
49404 :072,224,000,208,010,032,030
49410 :222,255,224,014,144,194,031
49416 :076,232,009,162,000,142,117
49422 :003,070,142,001,070,142,186
49428 :002,070,076,081,010,234,237
49434 :234,234,234,174,240,071,189
49440 :169,000,157,021,001,238,106
49446 :240,071,174,240,071,224,034
49452 :010,208,238,174,239,071,216
49458 :096,162,000,142,014,071,023
49464 :169,000,174,014,071,157,129
49470 :164,069,238,014,071,174,024
49476 :014,071,224,085,144,238,076
49482 :032,112,030,032,048,046,118
49488 :076,046,017,000,000,000,219
```

2. Load "PATCHPROGRAM",8,1 (the program above).

3. Type NEW.

4. Load the original bulletin board with a ,8.

5. POKE a 234 into the eight bytes from 3473 to 3480. For example, POKE3473,234 and so on, up to POKE3480,234.

6. Put a blank, formatted disk into your drive, and SYS49152 to run the patch program.

7. A new version of the C/G Bulletin Board will be automatically saved to your disk, under the name "BBS".

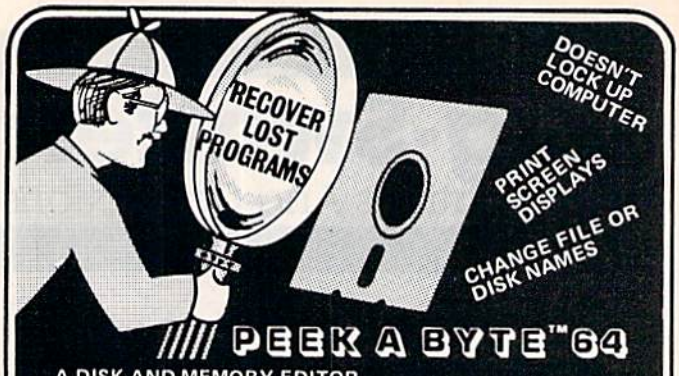
The procedure above applies to the version published in the GAZETTE and the program on the December DISK. It does not apply to the January DISK, which was corrected. We regret any inconvenience this may have caused our readers.

• There are two errors in the 64 version of "Jump!" (November 1984). **POKES1,30** should be changed to **POKES+1,30** in line 740, and **POKES4,0** should be **POKES+4,0** in line 760. These typos do not affect the play of the game, but may cause problems with later SAVEs and LOADs. Thanks to reader Bill J. Pitre for discovering these two bugs.

• "Trek" (October 1984) works as listed, but several readers have reported an incorrect Automatic Proofreader checksum for line 3220:

```
3220 PRINT"{HOME}{11 DOWN}{10 RIGHT} .
     {5 SPACES}.{GRN}.{3 SPACES}.
     {3 SPACES}";:T1=TI:GOSUB920:GOTO95
                                :rem 104
```

The period at the end of the first line was apparently taken for a scratch on the printer's negative and removed. This does not affect the program because after the PRINT statement is executed, there is a GOSUB to a routine that immediately clears the screen.



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DEMO PROGRAM
See *COMPUTE!'s GAZETTE* February, 1985 Disk

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Trademarks: Lotus 1-2-3/Lotus Development. Commodore 64/Commodore Electronics Ltd. Multiplan/Microsoft.

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Cypher

(Article on page 56.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: Cypher—64 Version

```
70 PRINT"{CLR}":POKE53280,6:POKE53281,12
                                    :rem 147
80 GOSUB1210                        :rem 172
90 PRINT:PRINT"{CLR}{WHT}{RVS}INSTRUCTION
   S ?{2 SPACES}Y/N{OFF}"            :rem 7
100 GETA$:IFA$=""THEN100            :rem 69
110 IFA$="Y"THENGOTO1060            :rem 143
120 IFA$<>"N"THEN100                :rem 83
130 PRINT"{CLR}":DIMA(5),Z(5),S(5),RC(8),
    GC(8)                           :rem 109
140 GLOC=1039:CGLOC=55311:ANS=1024:A$="":
    POKE54296,15                    :rem 231
150 HF=54273:LF=54272:HP=54275:LP=54274:A
    D=54277:SR=54278:WF=54276       :rem 233
160 CANS=55296:SLOC=1053:X=0        :rem 116
170 POKE649,1                       :rem 199
180 FORK=1TO12                      :rem 63
190 FORI=1TO6                       :rem 17
200 POKEGLOC,81:POKECGLOC,11        :rem 218
210 GLOC=GLOC+2:CGLOC=CGLOC+2       :rem 27
220 NEXTI                           :rem 28
230 GLOC=GLOC+68:CGLOC=CGLOC+68     :rem 149
240 NEXTK                           :rem 32
250 GLOC=1039:CGLOC=55311           :rem 164
260 FORL=0TO5                       :rem 16
270 B=INT(RND(1)*8)                 :rem 28
280 RC(B)=RC(B)+1                   :rem 131
290 A(L)=B                          :rem 248
300 POKEANS,90:POKECANS,2:GOSUB1510:ANS=A
    NS+2:CANS=CANS+2                :rem 92
310 NEXTL                           :rem 31
320 ANS=1024:CANS=55296             :rem 34
330 FORI=0TO5                       :rem 11
340 GETZ$:IFZ$=""THEN340            :rem 131
350 IFASC(Z$)=20THENGOTO1020        :rem 151
360 IFASC(Z$)<49ORASC(Z$)>57THEN340
                                    :rem 46
370 Z(I)=VAL(Z$)                    :rem 125
380 Z(I)=Z(I)-1                     :rem 30
390 IFZ(I)=8THEN800                 :rem 91
400 GC(Z(I))=GC(Z(I))+1             :rem 203
410 POKECGLOC,Z(I)                  :rem 76
420 GOSUB1330                       :rem 221
430 CGLOC=CGLOC+2                   :rem 1
440 NEXTI                           :rem 32
450 FORI=0TO7                       :rem 16
460 IFGC(I)<=RC(I)THENQ=Q+GC(I)     :rem 82
470 IFGC(I)>RC(I)THENQ=Q+RC(I)      :rem 35
480 NEXTI                           :rem 36
490 FORK=0TO5                       :rem 20
500 IFZ(K)=A(K)THENF=F+1            :rem 136
510 NEXTK                           :rem 32
520 IFQ=0THEN610                    :rem 170
530 IFF=0THEN580                    :rem 166
540 FORK=0TOF-1                     :rem 127
550 S(K)=91                         :rem 48
560 NEXTK                           :rem 37
570 IFF=QTHEN610                    :rem 197
580 FORK=FTOQ-1                     :rem 164
590 S(K)=87                         :rem 57
600 NEXTK                           :rem 32
610 FORK=0TO5                       :rem 14
620 POKESLOC,S(K)                   :rem 19
630 POKESLOC+54272,0                :rem 132
640 SLOC=SLOC+2                     :rem 150
650 NEXTK                           :rem 37
660 SLOC=SLOC+68                    :rem 212
670 CGLOC=CGLOC+68                  :rem 67
680 I=0                             :rem 84
690 X=X+1                           :rem 232
700 IFF=6THEN800                    :rem 166
710 IFX=12GOTO800                   :rem 240
720 FORK=0TO5                       :rem 16
730 S(K)=0                          :rem 246
740 NEXTK                           :rem 37
750 Q=0:F=0                         :rem 71
760 FORK=0TO7                       :rem 22
770 GC(K)=0                         :rem 49
780 NEXTK                           :rem 41
790 GOTO330                         :rem 111
800 FORT=0TO5                       :rem 24
810 POKEANS,81                      :rem 63
820 POKECANS,A(T)                   :rem 0
830 GOSUB1420                       :rem 226
840 ANS=ANS+2:CANS=CANS+2           :rem 24
850 NEXT                            :rem 220
860 IFZ(I)=8OR(X=12ANDF<6)GOTO910:rem 222
870 PRINT"":PRINT"":PRINT""         :rem 134
880 PRINT"{BLK} YOU WON!!":PRINT"{DOWN}
    {BLK} MOVES:"X                  :rem 252
890 GOTO920                         :rem 117
910 PRINT"{BLK}{3 DOWN} YOU LOSE!!"
                                    :rem 160
920 PRINT:PRINT                     :rem 239
930 PRINT"{14 DOWN} PRESS ANY KEY"
                                    :rem 185
940 GETC$:IFC$=""THEN940            :rem 97
960 PRINT"{CLR}{WHT}{2 DOWN}{2 SPACES}WOU
    LD YOU LIKE TO TRY AGAIN ?{2 SPACES}
    {RVS}Y/N{OFF}"                  :rem 146
970 GETA$                           :rem 229
980 IFA$=""THEN970                  :rem 229
990 IFA$="Y"THENRUN90               :rem 253
1000 IFA$<>"N"THEN970               :rem 144
1009 PRINT"{CLR}":POKE54296,0       :rem 253
1010 POKE53280,14:POKE53281,6:PRINT"{7}":
     POKE649,10:END                 :rem 161
1020 FORDE=I*2TO1STEP-1:POKECGLOC-DE,12:G
     OSUB1510:NEXTDE                :rem 28
1030 FORRE=0TO8:GC(RE)=0:NEXTRE     :rem 179
1040 CGLOC=CGLOC-(I*2)              :rem 245
1050 GOTO330                        :rem 149
1060 PRINT"{CLR}THIS IS A CODE BREAKING G
     AME. SIX OF{2 SPACES}"         :rem 111
1065 PRINT"EIGHT RANDOM COLORS WILL BE CH
     OSEN."                         :rem 78
1070 PRINT"A COLOR MAY BE CHOSEN MORE THA
     N ";                           :rem 32
1075 PRINT"ONCE.{3 SPACES}AFTER THE SIX D
     IAMONDS{SHIFT-SPACE}COVERING THE"
                                    :rem 101
1080 PRINT"CODE APPEAR, ENTER YOUR GUESS
     {SPACE}WITH THE{2 SPACES}COLOR KEYS.
     "                              :rem 244
```

```
1090 PRINT"AFTER YOUR SIX COLORS ARE ENTE
     RED YOUR{2 SPACES}SCORE WILL APPEAR.
     "                                  :rem 235
1100 PRINT"":PRINT"SCORING IS:"         :rem 137
1110 PRINT"+=CORRECT COLOR CORRECT LOCATI
     ON"                                :rem 248
1120 PRINT"0=CORRECT COLOR WRONG LOCATION
     "                                  :rem 121
1130 PRINT"@=WRONG COLOR":PRINT""       :rem 42
1140 PRINT"THE SCORING MARKER LOCATIONS D
     ON'T"                              :rem 87
1145 PRINT"RELATE TO THE GUESS LOCATIONS.
     "                                  :rem 62
1150 PRINT"":PRINT"YOU HAVE 12 TURNS, IF
     {SPACE}YOU WISH TO SEE "           :rem 54
1160 PRINT"THE CODE AND QUIT THAT GAME EN
     TER 9.":PRINT""                    :rem 230
1170 PRINT"IF 5 OR LESS COLORS HAVE BEEN
     {SPACE}GUESSED"                    :rem 86
1175 PRINT"ENTER 'DEL' TO REMOVE THE GUES
     S."                                :rem 71
1180 PRINT"{DOWN}{RVS}{BLK}PRESS ANY KEY
     {OFF}"                             :rem 62
1190 GETR$:IFR$=""THEN1190              :rem 219
1200 GOTO130                            :rem 144
1210 PRINT"{WHT}{CLR}{10 DOWN}{9 RIGHT}
     {RVS}{3 SPACES}{OFF} {RVS} {OFF}
     {RVS} {OFF} {RVS}{3 SPACES}{OFF}
     {RVS} {OFF} {RVS} {OFF} {RVS}
     {3 SPACES}{OFF} {RVS}{3 SPACES}{OFF}
     "                                  :rem 252
1220 PRINTSPC(9)"{RVS} {OFF}{3 SPACES}
     {RVS}{3 SPACES}{OFF} {RVS} {OFF}
     {RVS} {OFF} {RVS} {OFF}{2 O}{RVS}
     {OFF} {RVS} {OFF}{2 O} {RVS} {OFF}
     {RVS} {OFF}"                       :rem 245
1230 PRINTTAB(9)"{RVS} {OFF}{4 SPACES}
     {RVS} {OFF}{2 SPACES}{RVS}{2 SPACES}
     {OFF}{2 SPACES}{RVS} {O} {OFF} {RVS}
      {2 O}{OFF} {RVS}{3 SPACES}{*}{OFF}"
                                        :rem 218
1240 FORD=1TO9:PRINT" ";:NEXTD          :rem 63
1250 PRINT"{RVS}{3 SPACES}{OFF}{2 SPACES}
     {RVS} {OFF}{2 SPACES}{RVS}{2 SPACES}
     {OFF}{2 SPACES}{RVS} {OFF} {RVS}
     {OFF} {RVS}{3 SPACES}{OFF} {RVS}
     {OFF}{2 SPACES}{RVS} {OFF}" :rem 185
1310 FORD=1TO2000:NEXT                  :rem 60
1320 RETURN                             :rem 166
1330 IFZ(I)=0THENHI=34:LO=75:GOTO1520
                                        :rem 212
1340 IFZ(I)=1THENHI=38:LO=126:GOTO1520
                                          :rem 7
1350 IFZ(I)=2THENHI=43:LO=52:GOTO1520
                                        :rem 211
1360 IFZ(I)=3THENHI=45:LO=198:GOTO1520
                                         :rem 18
1370 IFZ(I)=4THENHI=51:LO=97:GOTO1520
                                        :rem 223
1380 IFZ(I)=5THENHI=57:LO=172:GOTO1520
                                         :rem 17
1390 IFZ(I)=6THENHI=64:LO=188:GOTO1520
                                         :rem 24
1400 IFZ(I)=7THENHI=68:LO=149:GOTO1520
                                         :rem 18
1410 RETURN                             :rem 166
1420 IFA(T)=0THENHI=34:LO=75:GOTO1520
                                        :rem 198
1430 IFA(T)=1THENHI=38:LO=126:GOTO1520
                                        :rem 249
1440 IFA(T)=2THENHI=43:LO=52:GOTO1520
                                        :rem 197
1450 IFA(T)=3THENHI=45:LO=198:GOTO1520
                                          :rem 4
1460 IFA(T)=4THENHI=51:LO=97:GOTO1520
                                        :rem 209
1470 IFA(T)=5THENHI=57:LO=172:GOTO1520
                                          :rem 3
1480 IFA(T)=6THENHI=64:LO=188:GOTO1520
                                         :rem 10
1490 IFA(T)=7THENHI=68:LO=149:GOTO1520
                                         :rem 13
1500 RETURN                             :rem 166
1510 HI=45:LO=198                       :rem 178
1520 POKEHF,HI:POKELF,LO                  :rem 4
1530 POKEHP,0:POKELP,255                :rem 185
1540 POKEAD,9:POKESR,0                   :rem 77
1550 POKEWF,65                           :rem 46
1560 FORSO=1TO150:NEXTSO                 :rem 23
1570 POKEWF,64                           :rem 47
1580 RETURN                             :rem 174
```

Program 2: Cypher—VIC Version

```
90 POKE36879,232:GOSUB1210:PRINT:PRINT"
   {CLR}{BLK}{RVS}{3 SPACES}INSTRUCTIONS
   {2 SPACES}Y/N{2 SPACES}{OFF}"  :rem 14
100 GETA$:IFA$=""THEN100          :rem 69
110 IFA$="Y"THENGOTO1060         :rem 143
120 IFA$<>"N"THEN100              :rem 83
130 PRINT"{CLR}":DIMA%(5),Z%(5),S%(5),RC%
    (8),GC%(8)                    :rem 38
140 GLOC=7688:CGLOC=38408:ANS=7680:A$="":
    POKE36878,15                  :rem 19
150 HF=36876:LF=36875            :rem 133
160 CANS=38400:SLOC=7695:X=0:FORK=1TO12:F
    ORI=1TO6                      :rem 11
210 POKEGLOC,81:POKECGLOC,1:GLOC=GLOC+1:C
    GLOC=CGLOC+1:NEXTI            :rem 44
230 GLOC=GLOC+38:CGLOC=CGLOC+38:NEXTK:GLO
    C=7688:CGLOC=38408           :rem 178
260 FORL=0TO5:B=INT(RND(1)*8):RC%(B)=RC%(
    B)+1:A%(L)=B                 :rem 246
300 POKEANS,90:POKECANS,2:GOSUB1510:ANS=A
    NS+1:CANS=CANS+1:NEXTL        :rem 31
320 ANS=7680:CANS=38400           :rem 36
330 FORI=0TO5                     :rem 11
340 GETZ$:IFZ$=""THEN340         :rem 131
350 IFASC(Z$)=20THENGOTO1020     :rem 151
360 IFASC(Z$)<49ORASC(Z$)>57THEN340
                                  :rem 46
370 Z%(I)=VAL(Z$):Z%(I)=Z%(I)-1  :rem 169
390 IFZ%(I)=8THEN800             :rem 128
400 GC%(Z%(I))=GC%(Z%(I))+1       :rem 95
410 POKECGLOC,Z%(I):GOSUB1330:CGLOC=CGLOC
    +1:NEXT:FORI=0TO7            :rem 191
460 IFGC%(I)<=RC%(I)THENQ=Q+GC%(I)
                                  :rem 193
470 IFGC%(I)>RC%(I)THENQ=Q+RC%(I):rem 146
480 NEXTI:FORK=0TO5              :rem 213
500 IFZ%(K)=A%(K)THENF=F+1       :rem 210
520 NEXTK:IFQ=0THEN620           :rem 111
530 IFF=0THEN580                 :rem 166
540 FORK=0TOF-1                  :rem 127
550 S%(K)=91:NEXTK                :rem 25
570 IFF=QTHEN620                 :rem 198
580 FORK=FTOQ-1                  :rem 164
590 S%(K)=87:NEXTK                :rem 34
620 FORK=0TO5:POKESLOC,S%(K):POKESLOC+307
    20,0                          :rem 6
```

```
640 SLOC=SLOC+1                          :rem 149
650 NEXTK                                :rem 37
660 SLOC=SLOC+38                         :rem 209
670 CGLOC=CGLOC+38                       :rem 64
680 I=0                                  :rem 84
690 X=X+1                                :rem 232
700 IFF=6THEN800                         :rem 166
710 IFX=12GOTO800                        :rem 240
720 FORK=0TO5                            :rem 16
730 S%(K)=0                              :rem 27
740 NEXTK                                :rem 37
750 Q=0:F=0                              :rem 71
760 FORK=0TO7                            :rem 22
770 GC%(K)=0                             :rem 86
780 NEXTK                                :rem 41
790 GOTO330                              :rem 111
800 FORT=0TO5                            :rem 24
810 POKEANS,81                           :rem 63
820 POKECANS,A%(T)                       :rem 37
830 GOSUB1420                            :rem 226
840 ANS=ANS+1:CANS=CANS+1                :rem 22
850 NEXTT                                :rem 48
860 POKE198,0:IFZ%(I)=8OR(X=12ANDF<6)GOTO
    910                                  :rem 106
880 PRINT"{CLR}{3 DOWN}{2 SPACES}YOU WON
    {SPACE}IN"X"MOVES":PRINT"{8 SPACES}";
                                         :rem 43
890 GOTO930                              :rem 118
910 PRINT"{3 DOWN}{BLK}YOU LOSE"         :rem 94
930 PRINT"{2 DOWN} {RVS}PRESS{2 DOWN}
    {4 LEFT}ANY{2 DOWN}{3 LEFT}KEY"
                                         :rem 142
940 GETC$:IFC$=""THEN940                 :rem 97
960 PRINT"{CLR}{2 DOWN}{BLK}WOULD YOU LIK
    E TO TRY AGAIN ?{2 SPACES}{RVS}Y/N
    {OFF}"                               :rem 29
980 GETA$:IFA$=""THEN980                 :rem 101
990 IFA$="Y"THENRUN130                   :rem 40
1000 IFA$<>"N"THEN980                    :rem 145
1010 PRINT"{CLR}":END                    :rem 55
1020 FORDE=1TO1STEP-1:POKECGLOC-DE,12:GOS
     UB1510:NEXTDE                       :rem 192
1030 FORRE=0TO8:GC%(RE)=0:NEXTRE         :rem 216
1040 CGLOC=CGLOC-(I*1)                   :rem 244
1050 GOTO330                             :rem 149
1060 PRINT"{CLR}THIS IS A CODE BREAK- ING
      GAME. SIX OF EIGHTRANDOM COLORS WIL
     L BE"                               :rem 95
1070 PRINT"CHOSEN. A COLOR MAY BECHOSEN M
     ORE THAN ONCE.AFTER THE SIX DIAMONDS
     ";                                  :rem 247
1080 PRINT"COVERING THE CODE{5 SPACES}APP
     EAR, ENTER YOUR{4 SPACES}GUESS WITH
     {SPACE}THE COLOR{2 SPACES}KEYS."
                                         :rem 50
1090 PRINT"AFTER YOUR SIX COLORS ARE ENTE
     RED YOUR SCOREWILL APPEAR."         :rem 235
1092 PRINT"{5 SPACES}{DOWN}{RVS}PRESS ANY
      KEY"                               :rem 30
1095 GETA$:IFA$=""THEN1095               :rem 193
1100 PRINT"{CLR}{DOWN}SCORING IS:":rem 34
1110 PRINT"+=CORRECT COLOR{9 SPACES}CORRE
     CT LOCATION"                        :rem 248
1120 PRINT"0=CORRECT COLOR WRONG
     {3 SPACES}LOCATION"                 :rem 121
1130 PRINT"@=WRONG COLOR"                :rem 31
1140 PRINT"{DOWN}THE SCORING MARKER
     {4 SPACES}LOCATIONS DON'T RELATETO T
     HE GUESS LOCATIONS"                 :rem 220
1150 PRINT"YOU HAVE 12 TURNS, IF YOU WISH
      TO SEE "                           :rem 43
1160 PRINT"THE CODE AND QUIT THATGAME ENT
     ER '9'."                            :rem 41
1170 PRINT"{DOWN}IF 5 OR LESS COLORS
     {3 SPACES}HAVE BEEN GUESSED":rem 103
1175 PRINT"ENTER 'DEL' TO REMOVE THE GUES
     S."                                 :rem 71
1180 PRINT"{5 SPACES}{RVS}PRESS ANY KEY
     {OFF}"                              :rem 157
1190 GETR$:IFR$=""THEN1190               :rem 219
1200 GOTO130                             :rem 144
1210 PRINT"{PUR}{CLR}{10 DOWN}{RVS}
     {2 SPACES}{OFF} {RVS} {OFF} {RVS}
     {OFF} {RVS}{3 SPACES}{OFF} {RVS}
     {OFF} {RVS} {OFF} {RVS}{3 SPACES}
     {OFF} {RVS}{3 SPACES}{OFF}";:rem 201
1220 PRINT"{RVS} {OFF}{2 SPACES}{RVS}
     {3 SPACES}{OFF} {RVS} {OFF} {RVS}
     {OFF} {RVS} {OFF}{SHIFT-O}{RVS} {OFF}
     {RVS} {OFF}{2 SHIFT-O} {RVS} {OFF} {RVS}
     {OFF}";                             :rem 192
1230 PRINT"{RVS} {OFF}{3 SPACES}{RVS}
     {OFF}{2 SPACES}{RVS}{3 SPACES}{OFF}
     {SPACE}{RVS} {SHIFT-O} {OFF} {RVS} {2 SHIFT-O}
     {OFF} {RVS}{2 SPACES}{SHIFT-*}{OFF}";
                                         :rem 180
1250 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}
     {RVS} {OFF}{2 SPACES}{RVS} {OFF}
     {3 SPACES}{RVS} {OFF} {RVS} {OFF}
     {RVS}{3 SPACES}{OFF} {RVS} {OFF}
     {RVS} {OFF}";                       :rem 244
1310 FORD=1TO2000:NEXTD                  :rem 128
1320 RETURN                              :rem 166
1330 IFZ%(I)=0THENHI=130:LO=130:GOTO1520
                                         :rem 78
1340 IFZ%(I)=1THENHI=175:LO=175:GOTO1520
                                         :rem 98
1350 IFZ%(I)=2THENHI=183:LO=183:GOTO1520
                                         :rem 98
1360 IFZ%(I)=3THENHI=191:LO=191:GOTO1520
                                         :rem 98
1370 IFZ%(I)=4THENHI=195:LO=195:GOTO1520
                                         :rem 108
1380 IFZ%(I)=5THENHI=201:LO=201:GOTO1520
                                         :rem 86
1390 IFZ%(I)=6THENHI=207:LO=207:GOTO1520
                                         :rem 100
1400 IFZ%(I)=7THENHI=209:LO=209:GOTO1520
                                         :rem 97
1410 RETURN                              :rem 166
1420 IFA%(T)=0THENHI=130:LO=130:GOTO1520
                                         :rem 64
1430 IFA%(T)=1THENHI=175:LO=175:GOTO1520
                                         :rem 84
1440 IFA%(T)=2THENHI=183:LO=183:GOTO1520
                                         :rem 84
1450 IFA%(T)=3THENHI=191:LO=191:GOTO1520
                                         :rem 84
1460 IFA%(T)=4THENHI=195:LO=195:GOTO1520
                                         :rem 94
1470 IFA%(T)=5THENHI=201:LO=201:GOTO1520
                                         :rem 72
1480 IFA%(T)=6THENHI=207:LO=207:GOTO1520
                                         :rem 86
1490 IFA%(T)=7THENHI=209:LO=209:GOTO1520
                                         :rem 92
1500 RETURN                              :rem 166
1510 HI=45:LO=198                        :rem 178
1520 POKEHF,HI:POKELF,LO                 :rem 4
```

```
1560 FORSO=1TO150:NEXTSO                :rem 23
1570 POKEHF,0:POKELF,0                  :rem 61
1580 RETURN                             :rem 174
```

The Forbidden Crypt

(Article on page 53.)

> BEFORE TYPING . . .
>
> **Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.**

Program 1: The Forbidden Crypt— VIC Loader

Note: Requires 8K or more expansion memory. See instructions in article before entering VIC version.

```
110 POKE44,32:POKE642,32:POKE8192,0:POKE6
    48,30:POKE36866,150:POKE36869,240:PRI
    NT"{CLR}"                           :rem 148
120 PRINT"FOR TAPE, PRESS PLAY.";:rem 205
130 S$="LO"+CHR$(34)+"A"+CHR$(34)+",8:"+C
    HR$(131)                            :rem 62
140 REM CHANGE 8 TO 1 IN LINE 130 IF USIN
    G A DATASETTE                       :rem 115
150 FORI=1TOLEN(S$):POKE630+I,ASC(MID$(S$
    ,I)):NEXT:POKE198,I:END             :rem 141
```

Program 2: The Forbidden Crypt— VIC Custom Characters

```
100 CS=4096:PRINT"{CLR}":FORA=0TO255:POKE
    7680+A,A:POKE38400+A,0:NEXTA:POKE3686
    9,252                               :rem 34
110 FORA=0TO2047:POKEA+CS,PEEK(32768+A):N
    EXTA                                :rem 212
120 FORA=0TO1023:READB:POKECS+A,B:NEXTA:P
    OKE36869,240                        :rem 247
130 FORA=0TO85:READB:POKE7168+A,B:NEXTA
                                        :rem 164
140 PRINT"{CLR}FOR TAPE, PRESS PLAY.";
                                        :rem 98
150 S$="LO"+CHR$(34)+"B"+CHR$(34)+",8:"+C
    HR$(131)                            :rem 65
160 REM CHANGE 8 TO 1 IN LINE 150 IF YOU
    {SPACE}ARE USING A DATASETTE        :rem 76
170 FORI=1TOLEN(S$):POKE630+I,ASC(MID$(S$
    ,I)):NEXT:POKE198,I:END             :rem 143
180 DATA60,126,219,255,255,219,102,60,0,0
    ,0,0,24,60,90,24                    :rem 10
190 DATA0,64,32,240,240,32,64,0,24,90,60,
    24,0,0,0,0                          :rem 205
200 DATA0,2,4,15,15,4,2,0,0,56,56,184,144
    ,254,18,18                          :rem 225
210 DATA16,40,68,68,68,68,198,0,2,63,150,
    254,18,40,198,0                     :rem 1
220 DATA0,3,118,124,112,0,0,0,0,192,96,51
    ,30,0,0,0                           :rem 142
230 DATA40,56,214,243,219,14,0,0,60,122,2
    47,129,126,122,122,122              :rem 47
240 DATA30,62,24,24,60,126,126,60,24,52,8
    2,255,74,44,24,0                    :rem 21
250 DATA144,96,112,184,28,14,7,3,28,116,3
    1,127,15,4,4,12                     :rem 232
260 DATA12,24,240,224,224,96,32,96,20,29,
    106,252,252,36,36,108               :rem 25
270 DATA124,66,66,124,72,68,66,0,16,16,16
    ,8,15,0,0,0                         :rem 35
280 DATA8,8,8,16,240,0,0,0,72,72,84,35,20
    ,8,7,0                              :rem 36
290 DATA18,18,42,196,40,16,224,0,129,129,
    66,36,153,189,126,60                :rem 251
300 DATA60,126,189,153,36,66,129,129,34,3
    4,34,220,124,220,34,34              :rem 74
310 DATA60,90,90,126,36,36,24,0,60,32,32,
    32,32,32,60,0                       :rem 112
320 DATA12,16,16,60,16,112,110,0,60,4,4,4
    ,4,4,60,0                           :rem 151
330 DATA0,8,28,42,8,8,8,8,0,0,16,32,127,3
    2,16,0                              :rem 30
340 DATA0,0,0,0,0,0,0,0,8,8,8,8,0,0,8,0
                                        :rem 109
350 DATA36,36,36,0,0,0,0,0,36,36,126,36,1
    26,36,36,0                          :rem 224
360 DATA8,30,40,28,10,60,8,0,0,98,100,8,1
    6,38,70,0                           :rem 178
370 DATA48,72,72,48,74,68,58,0,60,24,24,2
    4,24,24,60                          :rem 152
380 DATA0,0,63,63,63,63,60,60,0,0,252,252
    ,252,252,60,60                      :rem 169
390 DATA60,60,252,252,252,252,0,0,60,60,6
    3,63,63,63,0,0                      :rem 170
400 DATA0,0,255,255,255,255,0,0,60,60,60,
    60,60,60,60,60                      :rem 162
410 DATA0,0,0,0,0,24,24,0,0,2,4,8,16,32,6
    4,0                                 :rem 99
420 DATA60,66,70,90,98,66,60,0,8,24,40,8,
    8,8,62,0                            :rem 155
430 DATA60,66,2,12,48,64,126,0,60,66,2,28
    ,2,66,60,0                          :rem 237
440 DATA4,12,20,36,126,4,4,0,126,64,120,4
    ,2,68,56,0                          :rem 222
450 DATA28,32,64,124,66,66,60,0,126,66,4,
    8,16,16,16,0                        :rem 91
460 DATA60,66,66,60,66,66,60,0,60,66,66,6
    2,2,4,56,0                          :rem 1
470 DATA0,0,8,0,0,8,0,0,0,0,8,0,0,8,8,16
                                        :rem 168
480 DATA14,24,48,96,48,24,14,0,0,0,126,0,
    126,0,0,0                           :rem 169
490 DATA112,24,12,6,12,24,112,0,60,66,2,1
    2,16,0,16,0                         :rem 0
500 DATA0,64,32,240,240,32,64,0,0,2,4,15,
    15,4,2,0                            :rem 101
510 DATA0,0,0,0,24,60,90,24,0,0,0,0,240,4
    8,80,144                            :rem 98
520 DATA0,0,0,0,15,12,10,9,24,90,60,24,0,
    0,0,0                               :rem 195
530 DATA144,80,48,240,0,0,0,0,9,10,12,15,
    0,0,0,0                             :rem 44
540 DATA4,4,4,4,4,4,4,4,0,0,0,0,224,16,8,
    8                                   :rem 22
550 DATA8,8,8,4,3,0,0,0,8,8,8,16,224,0,0,
    0                                   :rem 30
560 DATA128,128,128,128,128,128,128,255,1
    28,64,32,16,8,4,2,1                 :rem 194
570 DATA1,2,4,8,16,32,64,128,255,128,128,
    128,128,128,128,128                 :rem 195
580 DATA255,1,1,1,1,1,1,1,0,60,126,126,12
    6,126,60,0                          :rem 206
590 DATA0,0,0,0,0,0,255,0,54,127,127,127,
    62,28,8,0                           :rem 169
600 DATA64,64,64,64,64,64,64,64,0,0,0,0,3
    ,4,8,8                              :rem 43
610 DATA129,66,36,24,24,36,66,129,0,60,66
    ,66,66,66,60,0                      :rem 207
620 DATA8,28,42,119,42,8,8,0,2,2,2,2,2,2,
    2,2                                 :rem 127
```

```
630 DATA8,28,62,127,62,28,8,0,8,8,8,8,255
    ,8,8,8                              :rem 73
640 DATA160,80,160,80,160,80,160,80,8,8,8
    ,8,8,8,8,8                          :rem 4
650 DATA0,0,1,62,84,20,20,0,255,127,63,31
    ,15,7,3,1                           :rem 166
660 DATA0,0,0,0,0,0,0,0,240,240,240,240,2
    40,240,240,240                      :rem 122
670 DATA0,0,0,0,255,255,255,255,255,0,0,0
    ,0,0,0,0                            :rem 103
680 DATA0,0,0,0,0,0,0,255,128,128,128,128
    ,128,128,128,128                    :rem 16
690 DATA170,85,170,85,170,85,170,85,1,1,1
    ,1,1,1,1,1                          :rem 233
700 DATA0,0,0,0,170,85,170,85,255,254,252
    ,248,240,224,192,128                :rem 226
710 DATA3,3,3,3,3,3,3,3,8,8,8,8,15,8,8,8
                                        :rem 204
720 DATA0,0,0,0,15,15,15,15,8,8,8,8,15,0,
    0,0                                 :rem 117
730 DATA0,0,0,0,248,8,8,8,0,0,0,0,0,0,255
    ,255                                :rem 166
740 DATA0,0,0,0,15,8,8,8,8,8,8,8,255,0,0,
    0                                   :rem 35
750 DATA0,0,0,0,255,8,8,8,8,8,8,8,248,8,8
    ,8                                  :rem 116
760 DATA192,192,192,192,192,192,192,192,2
    24,224,224,224,224,224,224,224
                                        :rem 235
770 DATA7,7,7,7,7,7,7,7,255,255,0,0,0,0,0
    ,0                                  :rem 92
780 DATA255,255,255,0,0,0,0,0,0,0,0,0,0,2
    55,255,255                          :rem 213
790 DATA1,1,1,1,1,1,1,255,0,0,0,0,240,240
    ,240,240                            :rem 89
800 DATA15,15,15,15,0,0,0,0,8,8,8,8,248,0
    ,0,0                                :rem 172
810 DATA240,240,240,240,0,0,0,0,240,240,2
    40,240,15,15,15,15                  :rem 79
820 DATA169,0,141,52,3                  :rem 100
830 DATA141,56,3,169,127                :rem 211
840 DATA141,34,145,173,32               :rem 253
850 DATA145,41,128,208,8                :rem 211
860 DATA169,1,141,52,3                  :rem 105
870 DATA76,40,28,173,17                 :rem 167
880 DATA145,41,16,208,5                 :rem 159
890 DATA169,2,141,52,3                  :rem 109
900 DATA173,17,145,41,4                 :rem 153
910 DATA208,12,173,52,3                 :rem 150
920 DATA24,105,3,141,52                 :rem 145
930 DATA3,76,75,28,173                  :rem 119
940 DATA17,145,41,8,208                 :rem 160
950 DATA9,173,52,3,24                   :rem 60
960 DATA105,6,141,52,3                  :rem 101
970 DATA173,17,145,41,32                :rem 209
980 DATA208,3,238,56,3,96               :rem 14
```

Program 3: The Forbidden Crypt—VIC Version (Main Program)

```
20 DIMMN(4,6),DR(8),RM(4)               :rem 89
30 FORI=1TO4:FORJ=1TO6:READMN(I,J):NEXTJ:
   NEXTI:FORI=1TO8:READDR(I):NEXT:rem 194
40 FORI=1TO4:RM(I)=1:NEXT               :rem 51
50 DATA7792,5,6,22,7,1,7802,8,9,1,10,5,79
   46,15,16,1,17,2,7956,23,24,22,25,4
                                        :rem 163
60 DATA1,-1,-22,-21,-23,22,23,21        :rem 34
70 DEFFNY(X)=INT(X/22):DEFFNX(X)=X-(FNY(X
   )*22):DEFFNA(X)=INT(RND(1)*X)+1:rem 73
80 TP$="(,,,,,,,,,,,,,,,,,,,)":BT$="+,,,
   ,,,,,,,,,,,,,,,,,*"                  :rem 172
90 SI$="-{20 SPACES}-":ML$="{RED}@@@@@@@@
   @":LV=1:SC=0:MQ=1                    :rem 165
100 POKE36878,10:POKE36879,8:POKE36869,25
    2:C=30720:P=7910                    :rem 199
110 IFTC=4THENTC=0:GOSUB790             :rem 182
120 GOSUB180                            :rem 172
130 GOSUB430:P=(MN(RM,1)+8)+9*(P1=-1)
                                        :rem 9
140 IFMQ<>11THENGOTO110                 :rem 152
150 PRINT"{CLR}{10 DOWN}{YEL}{6 RIGHT}
    {RVS}GAME OVER{OFF}"                :rem 234
160 PRINT"{DOWN}{4 RIGHT}{RVS}PRESS ANY K
    EY":PRINT"{4 RIGHT}{RVS}TO PLAY AGAIN
    {OFF}"                              :rem 185
170 POKE198,0:WAIT 198,1:PRINT"{BLU}":RUN
                                        :rem 140
180 GOSUB690:GOSUB710:PRINT"{BLU}":FORI=1
    TO4:IFRM(I)=0THENPOKEMN(I,1)+3,160
                                        :rem 99
190 NEXT:POKEP,46:POKEP+C,2:GOSUB760
                                        :rem 4
200 SYS7168:P1=DR(PEEK(820)):TP=PEEK(P+P1
    )                                   :rem 227
210 IF(TP<>32)AND(TP<>39)THEN200        :rem 101
220 P=P+P1:IFTP=32THENPOKEP-P1,32:POKEP+C
    ,2:POKEP,46:GOTO200                 :rem 242
230 TP=P:FORI=1TO4:IF(MN(I,1)=P)OR(MN(I,1
    )+7=P)THENRM=I:I=5                  :rem 106
240 NEXTI:P=7897+(17*(P=MN(RM,1))):MT=MN(
    RM,2):MB=MN(RM,3):MP=MN(RM,4):rem 136
250 MD=MN(RM,5):MC=MN(RM,6)             :rem 69
260 IFRM(RM)=1THENPOKEP-P1,32:POKEP+C,2:P
    OKEP,46:RETURN                      :rem 255
270 P=TP-P1:GOTO200                     :rem 125
280 FORI=1TO4:MM=MM+1:IFMM=4THENMM=0
                                        :rem 32
290 IFM(MM)<>0THENI=6                   :rem 247
300 NEXTI                               :rem 27
310 IFI=5THENRETURN                     :rem 237
320 V1=P-7680:Y1=FNY(V1):X1=FNX(V1):V=M(M
    M)-7680:Y=FNY(V):X=FNX(V)           :rem 2
330 M=22*(Y>Y1)-22*(Y<Y1):M=M-1*(X<X1)+1*
    (X>X1):TM=M(MM)+M:Q=PEEK(TM)        :rem 239
340 R=PEEK(TM+MP)                       :rem 5
350 IF(Q=0)OR(R=0)THENMQ=MQ+1:GOTO410
                                        :rem 243
360 IF(M<>MP)AND(M<>-MP)THEN400         :rem 85
370 IFM=MPTHENIF(R<>0)AND(R<>32)THENRETUR
    N                                   :rem 191
380 IFM=-MPTHENIF(Q<>0)AND(R<>32)THENRETU
    RN                                  :rem 236
390 GOTO410                             :rem 106
400 IF(Q<>32)OR(R<>32)THENRETURN        :rem 214
410 POKEM(MM),32:POKEM(MM)+MP,32:POKETM+C
    ,MC:POKETM+MP+C,MC:POKETM,MT        :rem 142
420 POKETM+MP,MB:M(MM)=TM:RETURN        :rem 83
430 GOSUB690:GOSUB740:GOSUB760:POKEP,0:PO
    KEP+C,2                             :rem 252
440 FORI=0TO3                           :rem 11
441 X=FNA(19):Y=FNA(13):Z=7680+X+(Y*22)
                                        :rem 164
442 IFPEEK(Z)<>32THEN441                :rem 160
443 POKEZ,MT:POKEZ+MP,MB                :rem 55
450 POKEZ+C,MC:POKEZ+MP+C,MC:M(I)=Z:NEXTI
                                        :rem 123
470 X=FNA(18)+1:Y=FNA(12)+1:Z=X+7680+(Y*2
    2):IFPEEK(Z)<>32THEN470             :rem 158
480 TR=10+RM:TL=Z:POKETL,TR:POKETL+C,6
                                        :rem 207
```

```
490 SYS7168:P1=PEEK(820):C1=P1:P1=DR(P1)
                                    :rem 70
500 IFPEEK(P+P1+P1)=93THENRETURN    :rem 250
510 T=MQ:GOSUB280:TP=PEEK(P+P1+P1):IFMQ=T
    THEN540                         :rem 18
520 IFRM(RM)=0THENRM(RM)=1:SC=SC-300:TC=T
    C-1                             :rem 180
530 RETURN                          :rem 120
540 IF(TP<=45)AND(TP>=40)THENP1=0:C1=0
                                    :rem 222
550 IFPEEK(824)THENGOSUB610:GOTO490
                                    :rem 147
560 IF(P+P1)<>TLAND(P+P1+P1)<>TLTHEN570
                                    :rem 66
561 RM(RM)=0:TC=TC+1:SC=SC+300:GOSUB760:P
    OKETL+C,0:POKETL,32:TL=0:GOTO490
                                    :rem 21
570 G=PEEK(P+P1):H=PEEK(P+P1+P1):IF(G<>MT
    )AND(G<>MB)AND(H<>MT)AND(H<>MB)THEN58
    0                               :rem 39
575 MQ=MQ+1:IFRM(RM)=0THENRM(RM)=1:TC=TC-
    1:SC=SC-300                     :rem 205
576 RETURN                          :rem 130
580 IFC1=0THEN490                   :rem 217
590 POKEP+P2,32:POKEP,32:P=P+P1:POKEP+C,2
    :POKEP+P1+C,3                   :rem 31
600 POKEP,0:POKEP+P1,63+C1:P2=P1:C2=C1:GC
    TO490                           :rem 244
610 AL=P+P2:S=0:IFC2=0THENP2=22:C2=1:POKE
    36876,200                       :rem 167
620 S=S+1:POKEAL+((S-1)*P2),32:POKE36876,
    200-S*5:BL=PEEK(AL+(S*P2))      :rem 31
630 IF(BL=MT)OR(BL=MB)THENSC=SC+10:GOSUB7
    60:POKE36876,0:GOTO660          :rem 142
640 IFPEEK(AL+(S*P2))<>32THENPOKEP+P2,63+
    C2:POKE36876,0:RETURN            :rem 3
650 POKEAL+(S*P2),63+C2:POKEAL+(S*P2)+C,C
    L+1:GOTO620                     :rem 8
660 AC=AL+(S*P2):FORA=0TO3:POKE36877,200
                                    :rem 64
670 IFAC=M(A)ORAC=M(A)+MPTHENPOKEM(A),32:
    POKEM(A)+MP,32:M(A)=0:POKE36877,0:RET
    URN                             :rem 184
680 NEXTA:POKE36877,0:RETURN        :rem 12
690 PRINT"{CLR}";:PRINTTP$;:FORI=1TO17:PR
    INTSI$;:NEXT:PRINTBT$;          :rem 226
700 RETURN                          :rem 119
710 PRINT"{HOME}{3 DOWN}";:FORB=1TO2:PRIN
    T"{2 RIGHT}(,,,,,,){2 SPACES}(,,,,,,)
    {2 RIGHT}";                     :rem 252
720 PRINT"{2 RIGHT}-{6 SPACES}-{2 SPACES}
    -{6 SPACES}-{2 RIGHT}";:PRINT"
    {2 RIGHT}'{6 SPACES}'{2 SPACES}'
    {6 SPACES}'{2 RIGHT}";          :rem 35
730 PRINT"{2 RIGHT}-{6 SPACES}-{2 SPACES}
    -{6 SPACES}-{2 RIGHT}";:PRINT"
    {2 RIGHT}+,,,,,,*{2 SPACES}+,,,,,,*
    {2 DOWN}{2 RIGHT}";:NEXTB:RETURN
                                    :rem 57
740 PRINT"{HOME}{8 DOWN}";          :rem 66
750 FORI=1TO3:PRINT"-{20 RIGHT}-";:NEXT:R
    ETURN                           :rem 231
760 PRINT"{HOME}{19 DOWN}";         :rem 255
770 PRINTLEFT$(ML$,11-MQ)CHR$(13);:PRINT"
    {RVS}{YEL}{4 RIGHT}SCORE";SC;"{LEFT}
    {SPACE}LEVEL"LV"{OFF}";         :rem 149
780 PRINT"{HOME}";:PRINT"{BLU}";:RETURN
                                    :rem 61
790 FORI=1TO4:RM(I)=1:NEXT:LV=LV+1
                                    :rem 134
800 PRINT"{CLR}{7 DOWN}{7 RIGHT}{RVS}YOU
    {SPACE}HAVE":PRINT"{3 RIGHT}{RVS}ACHI
    EVED LEVEL"LV"{OFF}"            :rem 14
810 FORI=1TO2000:NEXT:RETURN        :rem 47
```

Program 4: The Forbidden Crypt—64 Version

```
100 PRINT"{CLR}{12 DOWN}{12 RIGHT}PLEASE
    {SPACE}WAIT"                    :rem 12
101 SN=54272:FORI=SNTOSN+24:POKEI,0:NEXT:
    AD=54277:SR=AD+1:LF=SN:LH=SN+1
                                    :rem 204
102 CR=SN+4:VL=54296                :rem 136
103 POKEAD,16:POKESR,240            :rem 171
104 POKEVL,15                       :rem 248
110 GOSUB820:GOSUB1810              :rem 48
115 T$="{RVS}{40 SPACES}{OFF}":P=5:SC=0:L
    V=1                             :rem 183
116 FORI=1TO4:RM(I)=0:NEXT          :rem 102
120 S$="{RVS}{2 SPACES}{OFF}{36 SPACES}
    {RVS}{2 SPACES}{OFF}"           :rem 211
125 POKE49194,7                      :rem 53
130 DEFFNRX(X)=INT(RND(1)*87)+X:DEFFNRY(Y
    )=INT(RND(1)*57)+Y:POKE53280,0
                                    :rem 247
140 POKE53281,0:PL=1524:PX=20:PY=12:OPL=1
    524:POKEPL,81:POKEPL+54272,4:EN=53269
                                    :rem 117
150 POKEEN,255:POKE49192,0:LV=1:SC=0:CS=5
    3278:CD=53279:GOSUB330:GOTO115
                                    :rem 237
160 PRINT"{CLR}";:PRINT:PRINTT$;S$;S$;:GO
    SUB180:PRINTS$;S$;:GOSUB180:PRINTS$;S
    $;T$                            :rem 79
170 PRINT"{HOME}":RETURN            :rem 150
180 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}
    {A}************{S}{2 SPACES}{A}*****
    ********{S}{2 SPACES}{RVS}{2 SPACES}
    {OFF}";                         :rem 41
190 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}-
    {13 SPACES}-{2 SPACES}-{13 SPACES}-
    {2 SPACES}{RVS}{2 SPACES}{OFF}";
                                    :rem 98
200 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}-
    {13 SPACES}-{2 SPACES}-{13 SPACES}-
    {2 SPACES}{RVS}{2 SPACES}{OFF}";
                                    :rem 90
210 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}I
    {13 SPACES}I{2 SPACES}I{13 SPACES}I
    {2 SPACES}{RVS}{2 SPACES}{OFF}";
                                    :rem 11
220 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}-
    {13 SPACES}-{2 SPACES}-{13 SPACES}-
    {2 SPACES}{RVS}{2 SPACES}{OFF}";
                                    :rem 92
230 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}-
    {13 SPACES}-{2 SPACES}-{13 SPACES}-
    {2 SPACES}{RVS}{2 SPACES}{OFF}";
                                    :rem 93
240 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}
    {Z}************{X}{2 SPACES}{Z}*****
    ********{X}{2 SPACES}{RVS}{2 SPACES}
    {OFF}";                         :rem 62
250 RETURN                          :rem 119
260 PRINT"{CLR}";:PRINT:PRINTT$;    :rem 120
270 FORI=1TO20:PRINTS$;:NEXT:PRINTT$:PRIN
    T"{HOME}":PRINT"{9 DOWN}";      :rem 106
280 D$="{L}{J}{36 SPACES}{L}{J}":PRINTD$;
    D$;D$;D$:RETURN                 :rem 139
```

```
290 PRINT"{HOME}{23 DOWN}{YEL}{2 SPACES}S
    CORE"SC"{3 SPACES}LEVEL"LV"{3 SPACES}
    LIVES"P"{7}":                    :rem 67
291 PRINT"{HOME}":RETURN             :rem 154
330 IFTC<>4THEN340                   :rem 48
335 TC=0:FORI=1TO4:RM(I)=0:NEXT:LV=LV+1:G
    OSUB880                          :rem 24
336 IFLV/4=INT(LV/4)THENP=P+1:V=7-INT(LV/
    4):IFV>=0THENPOKE49194,V         :rem 61
340 POKE49192,0:POKE53269,0:GOSUB160:GOSU
    B290:IFP=0THEN610                :rem 235
341 IFRM(1)=1THENPOKE1315,160        :rem 161
342 IFRM(2)=1THENPOKE1332,160        :rem 162
343 IFRM(3)=1THENPOKE1675,160        :rem 174
344 IFRM(4)=1THENPOKE1692,160        :rem 175
350 POKEPL,81:POKEPL+54272,4         :rem 140
360 M=PEEK(56320):M=(MAND15)         :rem 52
370 IFM=15 THEN 360                  :rem 225
380 DX=((M>8)AND(M<12))-(M<8)        :rem 40
390 DY=((M=6)OR(M=10)OR(M=14))-((M=5)OR(M
    =9)OR(M=13))                     :rem 185
400 PX=PX+DX:PY=PY+DY                :rem 121
410 PL=(PY*40)+1024+PX:IFPEEK(PL)<>32THEN
    430                              :rem 59
420 POKEOPL,32:POKEOPL+54272,0:POKEPL,81:
    POKEPL+54272,4:OPL=PL:GOTO360    :rem 88
430 IFPEEK(PL)<>9THENGOTO590         :rem 241
440 IFPY=7THENRM=1                   :rem 128
450 IFPY=16THENRM=3                  :rem 179
460 IFPX>19THENRM=RM+1               :rem 127
470 IFRM=1THENCL=6                   :rem 104
480 IFRM=2THENCL=7                   :rem 107
490 IFRM=3THENCL=5                   :rem 107
500 IFRM=4THENCL=2                   :rem 97
510 POKE53292,CL                     :rem 133
520 IFRM(RM)=1THENPX=PX-DX:PY=PY-DY:PL=(P
    Y*40)+1024+PX:OPL=PL:GOTO420     :rem 162
530 FORI=1TO4:POKE2040+I,230+RM:POKE53287
    +I,CL+1:NEXT:POKE2045,235+RM:GOSUB650
                                     :rem 202
540 X=PEEK(53248):Y=PEEK(53249)      :rem 247
550 IFX<=46THENPX=-3*((RM=1)OR(RM=3))-20*
    ((RM=2)OR(RM=4))                 :rem 29
560 IFX>46THENPX=-19*((RM=1)OR(RM=3))-36*
    ((RM=2)OR(RM=4))                 :rem 33
570 PY=-7*((RM=1)OR(RM=2))-16*((RM=3)OR(R
    M=4)):PL=(PY*40)+1024+PX:OPL=PL
                                     :rem 142
580 GOTO330                          :rem 108
590 PX=PX-DX:PY=PY-DY                :rem 135
600 GOTO360                          :rem 104
610 PRINT"{HOME}{7 DOWN}{16 RIGHT}{RVS}
    {YEL}GAME OVER{OFF}"             :rem 90
611 PRINT"{DOWN}{7 RIGHT}{RVS}PRESS ANY K
    EY TO PLAY AGAIN{7}{OFF}":POKE198,0
                                     :rem 129
612 WAIT198,1                        :rem 205
613 PRINT"{CLR}":RETURN              :rem 24
650 POKEOPL,32:POKEOPL+54272,0:POKEPL,81:
    POKEPL+54272,4:GOSUB260:GOSUB290
                                     :rem 250
660 IFPX=18ORPX=35THEN680            :rem 52
670 X=45:Y=145:POKE53264,PEEK(53264)AND25
    4:POKE49189,0:GOTO690            :rem 108
680 X=45:Y=145:POKE53264,PEEK(53264)OR1:P
    OKE49189,1                       :rem 192
690 POKE53248,X:POKE53249,Y:POKE53264,PEE
    K(53264)AND1:POKE53269,0         :rem 50
700 PL=53250:POKEPL,FNRX(58):POKEPL+1,FNR
    Y(67):POKEPL+2,FNRX(169)         :rem 227
710 POKEPL+3,FNRY(67):POKEPL+4,FNRX(58):P
    OKEPL+5,FNRY(146)                :rem 50
720 POKEPL+6,FNRX(167):POKEPL+7,FNRY(146)
                                     :rem 220
730 POKEPL+8,INT(RND(1)*222)+33:POKEPL+9,
    INT(RND(1)*139)+66:POKEEN,255    :rem 64
740 GOSUB900:POKE49178,0             :rem 134
750 SYS49152:A=PEEK(49178)           :rem 219
760 IFA=1THENPOKE49178,0:POKE49190,0:RETU
    RN                               :rem 136
770 IFA<>2THEN800                    :rem 225
780 POKE49178,0:POKE49190,0:P=P-1:IFRM(RM
    )=1THENRM(RM)=0:SC=SC-300:TC=TC-1
                                     :rem 207
785 FORI=20TO0STEP-1:POKELH,I:POKECR,17:F
    ORW=1TO20:NEXT:POKECR,16:NEXT    :rem 82
790 POKECR,0:POKE53261,0:RETURN      :rem 160
800 IFA<>3THEN810                    :rem 221
801 SC=SC+300:GOSUB290:TC=TC+1:POKE49178,
    0:RM(RM)=1:POKE53261,0           :rem 229
802 FORI=0TO100STEP10:POKELH,I:POKECR,17:
    FORW=1TO20:NEXT:POKECR,16:NEXT
                                     :rem 122
803 POKECR,0:GOTO750                 :rem 202
810 POKE49178,0:POKE49190,0:SC=SC+10:GOSU
    B290:GOTO750                     :rem 144
820 POKE2040,230:POKE2041,231:POKE2042,23
    2:POKE2043,233:POKE2044,234      :rem 36
830 POKE2045,236:POKE2046,235        :rem 87
840 CH=0:FORI=14720TO15359:READA:POKEI,A:
    CH=CH+A:NEXT                     :rem 11
845 IFCH<>45651THENPRINT"BAD DATA IN SPRI
    TE DEFINITIONS":END              :rem 214
850 RETURN                           :rem 125
880 POKEEN,0:PRINT"{CLR}{5 RIGHT}{5 DOWN}
    YOU HAVE ACHIEVED LEVEL ";LV" !"
                                     :rem 86
890 FORW=1TO1000:NEXT:RETURN         :rem 68
900 A=PEEK(49189):ONA+1GOTO910,920
                                     :rem 170
910 A=1424:GOTO930                   :rem 242
920 A=1462                           :rem 230
930 FORI=ATOA+120STEP40:POKEI,160:POKEI+1
    ,160:NEXTI:RETURN                :rem 174
960 DATA0,60,0,0,126,0,0,219         :rem 120
970 DATA0,0,255,0,0,255,0,0          :rem 70
980 DATA126,0,0,60,0,1,255,128       :rem 230
990 DATA3,255,192,3,126,192,3,126:rem 143
1000 DATA192,3,126,192,3,126,192,3
                                     :rem 174
1010 DATA126,192,0,102,0,0,102,0     :rem 43
1020 DATA0,102,0,0,102,0,0,102       :rem 186
1030 DATA0,0,102,0,0,231,0,0         :rem 91
1050 DATA0,0,0,0,0,0,0,0             :rem 148
1060 DATA112,0,0,216,0,1,240,0       :rem 201
1070 DATA1,192,0,1,192,0,0,224       :rem 216
1080 DATA0,0,56,0,0,28,0,0           :rem 12
1090 DATA14,0,240,14,131,252,14,199
                                     :rem 222
1100 DATA255,14,207,15,158,254,7,252
                                     :rem 25
1110 DATA124,3,248,56,0,224,0,0      :rem 12
1120 DATA0,0,0,0,0,0,0,0             :rem 146
1140 DATA0,0,0,12,0,48,30,0          :rem 54
1150 DATA120,18,24,72,51,60,204,97
                                     :rem 178
1160 DATA60,134,13,153,176,30,255,120
                                     :rem 65
1170 DATA51,127,204,45,255,180,110,255
                                     :rem 121
1180 DATA118,219,255,219,53,255,172,110
                                     :rem 182
1190 DATA255,118,219,255,219,48,60,12
                                     :rem 88
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1200 DATA32,24,4,96,0,6,64,0      :rem 127
1210 DATA2,64,0,2,0,0,0,0         :rem 208
1230 DATA0,24,0,0,60,0,0,126      :rem 105
1240 DATA0,0,195,0,0,195,0,0      :rem 115
1250 DATA102,0,0,60,0,0,255,0     :rem 155
1260 DATA1,255,128,3,189,192,3,189
                                  :rem 197
1270 DATA192,7,126,224,7,126,224,9
                                  :rem 189
1280 DATA126,144,16,255,8,9,126,144
                                  :rem 241
1290 DATA6,255,96,0,255,0,1,255    :rem 36
1300 DATA128,3,255,192,0,0,0,0    :rem 216
1320 DATA2,0,64,14,66,112,63,90    :rem 23
1330 DATA252,127,255,254,255,129,255,255
                                  :rem 239
1340 DATA165,255,221,129,187,136,195,17
                                  :rem 192
1350 DATA0,195,0,0,102,0,0,126    :rem 210
1360 DATA0,0,60,0,0,60,0,0          :rem 4
1370 DATA60,0,0,60,0,16,56,0      :rem 119
1380 DATA48,248,0,255,224,0,127,128
                                  :rem 237
1390 DATA0,48,0,0,16,0,0,16        :rem 69
1410 DATA0,0,0,0,0,0,0,0          :rem 148
1420 DATA0,0,0,0,0,0,0,0          :rem 149
1430 DATA0,0,0,126,0,1,153,128    :rem 212
1440 DATA2,60,64,6,255,96,6,255    :rem 44
1450 DATA96,2,60,64,1,153,128,0    :rem 30
1460 DATA126,0,0,0,0,0,0,0          :rem 2
1470 DATA0,0,0,0,0,0,0,0          :rem 154
1480 DATA0,0,0,0,0,0,0,255          :rem 7
1490 DATA0,0,0,0,0,0,0,0          :rem 156
1500 DATA0,0,0,0,0,0,0,0          :rem 148
1510 DATA0,0,0,0,0,0,0,0          :rem 149
1520 DATA0,0,0,63,255,252,96,0    :rem 227
1530 DATA6,192,0,3,255,255,255,192
                                  :rem 188
1540 DATA20,3,192,28,3,192,0,3    :rem 229
1550 DATA192,0,3,255,255,255,0,0   :rem 76
1560 DATA0,0,0,0,0,0,0,255          :rem 6
1570 DATA0,0,0,0,0,0,0,0          :rem 155
1580 DATA0,0,0,0,0,0,0,0          :rem 156
1590 DATA0,0,0,0,0,97,255,134     :rem 177
1600 DATA146,0,73,147,129,201,137,255
                                   :rem 76
1610 DATA145,135,255,225,128,255,1,65
                                  :rem 81
1620 DATA255,130,34,126,68,28,60,56
                                  :rem 240
1630 DATA0,255,0,3,255,192,31,255:rem 127
1640 DATA248,0,0,0,0,0,0,255      :rem 115
1650 DATA1,255,128,3,255,192,7,129
                                  :rem 192
1660 DATA224,12,195,48,24,102,24,56
                                  :rem 235
1670 DATA60,28,60,126,60,54,195,108
                                  :rem 242
1680 DATA51,153,204,49,189,140,49,189
                                  :rem 101
1690 DATA140,51,153,204,54,195,108,60
                                   :rem 79
1700 DATA126,60,56,60,28,24,102,24
                                  :rem 175
1710 DATA12,195,48,7,129,224,3,255
                                  :rem 191
1720 DATA192,1,255,128,0,0,0,0    :rem 220
1730 DATA0,0,0,0,0,0,0,0          :rem 153
1740 DATA0,0,0,0,0,126,0,0          :rem 3
1750 DATA195,0,0,195,0,0,126,0    :rem 226
1760 DATA0,60,0,0,60,0,0,60        :rem 62
1770 DATA0,0,126,0,0,255,0,0      :rem 114
1780 DATA255,0,1,255,128,1,255,128
                                  :rem 186
1790 DATA3,255,192,3,255,192,3,255
                                  :rem 196
1800 DATA192,1,255,128,0,255,0,0  :rem 71
1810 CH=0:I=49152:IFPEEK(I)=76THENRETURN
                                  :rem 200
1820 READ A:CH=CH+A:IFA=256THEN1840:rem 1
1830 POKEI,A:I=I+1:GOTO1820        :rem 84
1840 IFCH<>141279THENPRINT"BAD DATA ERROR
     IN ML DATA.":END             :rem 141
1850 RETURN                       :rem 174
1860 DATA 76,24,194,1,2,4         :rem 205
1870 DATA 8,16,32,64,128,254      :rem 106
1880 DATA 253,251,247,239,223,191:rem 102
1890 DATA 127,0,0,0,0,0            :rem 82
1900 DATA 0,0,0,0,0,0             :rem 224
1910 DATA 0,0,0,0,0,0             :rem 225
1920 DATA 0,0,0,0,0,0             :rem 226
1930 DATA 0,0,173,20,192,10        :rem 29
1940 DATA 168,141,19,192,185,0    :rem 205
1950 DATA 208,141,21,192,172,20   :rem 240
1960 DATA 192,185,3,192,45,16     :rem 159
1970 DATA 208,141,22,192,172,19   :rem 251
1980 DATA 192,185,1,208,141,23    :rem 200
1990 DATA 192,173,21,192,24,109   :rem 255
2000 DATA 24,192,141,21,192,201   :rem 226
2010 DATA 255,240,19,201,0,240    :rem 174
2020 DATA 3,76,129,192,172,20     :rem 142
2030 DATA 192,185,3,192,141,22    :rem 190
2040 DATA 192,76,129,192,173,24   :rem 254
2050 DATA 192,16,12,173,21,192    :rem 189
2060 DATA 201,255,208,5,169,0     :rem 140
2070 DATA 141,22,192,173,23,192   :rem 241
2080 DATA 24,109,25,192,141,23    :rem 190
2090 DATA 192,172,20,192,173,22   :rem 244
2100 DATA 192,240,12,185,3,192    :rem 187
2110 DATA 13,16,208,141,16,208    :rem 182
2120 DATA 76,168,192,185,11,192   :rem 255
2130 DATA 45,16,208,141,16,208    :rem 189
2140 DATA 172,19,192,173,21,192   :rem 247
2150 DATA 153,0,208,173,23,192    :rem 189
2160 DATA 201,66,144,9,201,205    :rem 186
2170 DATA 240,2,176,3,153,1        :rem 35
2180 DATA 208,169,0,141,24,192    :rem 195
2190 DATA 141,25,192,96,173,0     :rem 149
2200 DATA 220,41,15,201,15,208    :rem 172
2210 DATA 3,76,111,193,32,207     :rem 137
2220 DATA 193,32,44,192,173,1     :rem 142
2230 DATA 208,201,66,208,9,24     :rem 143
2240 DATA 105,1,141,1,208,76       :rem 83
2250 DATA 246,192,201,205,208,6   :rem 241
2260 DATA 56,233,1,141,1,208       :rem 85
2270 DATA 173,16,208,41,1,208     :rem 141
2280 DATA 42,173,0,208,201,39     :rem 140
2290 DATA 208,74,173,1,208,201    :rem 193
2300 DATA 130,144,22,201,161,176   :rem 21
2310 DATA 18,173,16,208,41,1       :rem 87
2320 DATA 205,37,192,240,8,169    :rem 200
2330 DATA 1,141,26,192,76,111     :rem 137
2340 DATA 193,238,0,208,76,78     :rem 159
2350 DATA 193,173,0,208,201,49    :rem 194
2360 DATA 208,32,173,1,208,201    :rem 185
2370 DATA 130,144,22,201,161,176   :rem 28
2380 DATA 18,173,16,208,41,1       :rem 94
2390 DATA 205,37,192,240,8,169    :rem 207
2400 DATA 1,141,26,192,76,111     :rem 135
2410 DATA 193,206,0,208,162,5     :rem 138
2420 DATA 32,54,195,173,32,192    :rem 199
2430 DATA 240,23,169,3,141,26     :rem 139
2440 DATA 192,160,5,185,11,192    :rem 196
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2450 DATA 45,21,208,141,21,208   :rem 186
2460 DATA 160,10,169,0,153,0      :rem 83
2470 DATA 208,173,38,192,208,90    :rem 2
2480 DATA 173,43,192,208,85,173    :rem 4
2490 DATA 0,220,41,16,208,78      :rem 94
2500 DATA 173,40,192,201,3,176   :rem 188
2510 DATA 71,169,50,141,43,192   :rem 196
2520 DATA 169,1,141,38,192,238   :rem 202
2530 DATA 40,192,169,10,141,1    :rem 136
2540 DATA 212,169,17,141,4,212   :rem 189
2550 DATA 162,2,32,15,194,169    :rem 150
2560 DATA 16,141,4,212,160,12    :rem 131
2570 DATA 173,0,208,153,0,208    :rem 140
2580 DATA 173,1,208,153,1,208    :rem 143
2590 DATA 173,16,208,41,1,240    :rem 142
2600 DATA 9,173,16,208,9,64       :rem 54
2610 DATA 141,16,208,96,173,16   :rem 199
2620 DATA 208,41,191,141,16,208  :rem 241
2630 DATA 96,168,41,1,208,8       :rem 55
2640 DATA 169,255,141,25,192,76    :rem 4
2650 DATA 230,193,152,41,2,208   :rem 190
2660 DATA 5,169,1,141,25,192      :rem 99
2670 DATA 152,41,4,208,8,169     :rem 104
2680 DATA 255,141,24,192,76,253    :rem 1
2690 DATA 193,152,41,8,208,5     :rem 104
2700 DATA 169,1,141,24,192,173   :rem 195
2710 DATA 38,192,208,12,173,24   :rem 197
2720 DATA 192,141,39,192,173,25  :rem 253
2730 DATA 192,141,41,192,96,160  :rem 251
2740 DATA 255,136,208,253,202,208 :rem 91
2750 DATA 248,96,169,0,141,20    :rem 153
2760 DATA 192,32,202,192,44,43   :rem 197
2770 DATA 192,240,3,206,43,192   :rem 198
2780 DATA 173,26,192,208,88,173   :rem 11
2790 DATA 38,192,240,21,32,13    :rem 145
2800 DATA 196,173,38,192,240,13  :rem 252
2810 DATA 173,26,192,208,70,32   :rem 198
2820 DATA 13,196,173,26,192,208  :rem 255
2830 DATA 62,174,42,192,32,15    :rem 148
2840 DATA 194,162,0,173,27,192   :rem 203
2850 DATA 24,105,1,201,5,208      :rem 84
2860 DATA 2,169,1,141,27,192     :rem 100
2870 DATA 141,20,192,168,185,3   :rem 203
2880 DATA 192,45,16,208,208,16   :rem 207
2890 DATA 152,10,168,185,0,208   :rem 201
2900 DATA 208,8,232,224,4,240    :rem 140
2910 DATA 161,76,79,194,32,139   :rem 215
2920 DATA 194,173,26,192,208,3   :rem 205
2930 DATA 76,24,194,169,0,141    :rem 155
2940 DATA 38,192,96,173,27,192   :rem 219
2950 DATA 10,168,185,0,208,141   :rem 196
2960 DATA 21,192,185,1,208,141   :rem 197
2970 DATA 23,192,173,23,192,205  :rem 252
2980 DATA 1,208,208,8,169,0       :rem 54
2990 DATA 141,23,192,76,187,194   :rem 12
3000 DATA 144,8,169,255,141,25   :rem 195
3010 DATA 192,76,187,194,169,1   :rem 210
3020 DATA 141,25,192,172,27,192  :rem 243
3030 DATA 185,3,192,45,16,208    :rem 147
3040 DATA 208,8,169,0,141,22      :rem 89
3050 DATA 192,76,211,194,169,1   :rem 202
3060 DATA 141,22,192,173,16,208  :rem 241
3070 DATA 41,1,205,22,192,240    :rem 131
3080 DATA 5,176,18,76,236,194    :rem 163
3090 DATA 173,21,192,205,0,208   :rem 189
3100 DATA 240,12,144,5,169,255   :rem 189
3110 DATA 76,248,194,169,1,76    :rem 162
3120 DATA 248,194,169,0,141,24   :rem 196
3130 DATA 192,173,24,192,73,255  :rem 252
3140 DATA 24,105,1,141,34,192    :rem 132
3150 DATA 173,25,192,73,255,24   :rem 201
3160 DATA 105,1,141,35,192,32    :rem 134
3170 DATA 44,192,32,33,195,173   :rem 202
3180 DATA 32,192,208,1,96,32      :rem 98
3190 DATA 229,195,96,162,0,236   :rem 210
3200 DATA 20,192,240,8,32,54      :rem 85
3210 DATA 195,173,32,192,208,5   :rem 198
3220 DATA 232,224,6,208,238,96   :rem 200
3230 DATA 173,20,192,10,168,185  :rem 245
3240 DATA 0,208,141,28,192,185   :rem 195
3250 DATA 1,208,141,29,192,138   :rem 196
3260 DATA 10,168,185,0,208,141   :rem 191
3270 DATA 30,192,185,1,208,141   :rem 192
3280 DATA 31,192,173,29,192,56   :rem 208
3290 DATA 233,19,205,31,192,176  :rem 251
3300 DATA 11,173,29,192,24,105   :rem 188
3310 DATA 19,205,31,192,176,6    :rem 146
3320 DATA 169,0,141,32,192,96    :rem 148
3330 DATA 172,20,192,185,3,192   :rem 196
3340 DATA 45,16,208,240,2,169    :rem 146
3350 DATA 1,141,33,192,138,168   :rem 197
3360 DATA 185,3,192,45,16,208    :rem 153
3370 DATA 240,2,169,1,205,33      :rem 89
3380 DATA 192,240,46,176,25,173    :rem 0
3390 DATA 28,192,56,233,15,176   :rem 210
3400 DATA 11,205,30,192,176,6    :rem 137
3410 DATA 169,1,141,32,192,96    :rem 149
3420 DATA 169,0,141,32,192,96    :rem 149
3430 DATA 173,28,192,24,105,15   :rem 195
3440 DATA 144,242,205,30,192,144  :rem 33
3450 DATA 237,169,1,141,32,192   :rem 198
3460 DATA 96,173,28,192,56,233   :rem 214
3470 DATA 15,176,2,169,0,205      :rem 97
3480 DATA 30,192,176,216,173,28    :rem 0
3490 DATA 192,24,105,15,144,2    :rem 143
3500 DATA 169,255,205,30,192,144  :rem 41
3510 DATA 201,169,1,141,32,192   :rem 186
3520 DATA 96,138,240,31,173,34   :rem 199
3530 DATA 192,141,24,192,173,35  :rem 248
3540 DATA 192,141,25,192,32,44   :rem 196
3550 DATA 192,173,34,192,141,24  :rem 249
3560 DATA 192,173,35,192,141,25  :rem 252
3570 DATA 192,32,44,192,96,169   :rem 217
3580 DATA 2,141,26,192,96,160    :rem 152
3590 DATA 12,185,1,208,201,66    :rem 146
3600 DATA 240,106,201,205,240,102 :rem 63
3610 DATA 173,16,208,41,1,208    :rem 140
3620 DATA 7,185,0,208,201,39      :rem 95
3630 DATA 240,88,185,0,208,201   :rem 195
3640 DATA 49,240,81,173,39,192   :rem 210
3650 DATA 141,24,192,173,41,192  :rem 248
3660 DATA 141,25,192,169,6,141   :rem 202
3670 DATA 20,192,32,44,192,160   :rem 196
3680 DATA 12,185,1,208,201,66    :rem 146
3690 DATA 240,52,201,205,240,48  :rem 241
3700 DATA 173,16,208,41,64,208   :rem 197
3710 DATA 10,185,0,208,201,39    :rem 137
3720 DATA 240,34,76,104,196,185  :rem 255
3730 DATA 0,208,201,49,240,24    :rem 137
3740 DATA 162,1,32,54,195,173    :rem 150
3750 DATA 32,192,208,22,232,224  :rem 243
3760 DATA 5,208,243,76,122,196   :rem 208
3770 DATA 169,0,141,26,192,96    :rem 160
3780 DATA 169,0,141,26,192,76    :rem 159
3790 DATA 171,196,138,24,105,3   :rem 205
3800 DATA 141,26,192,138,168,185  :rem 52
3810 DATA 11,192,45,21,208,141   :rem 188
3820 DATA 21,208,185,11,192,45   :rem 197
3830 DATA 16,208,141,16,208,152  :rem 244
3840 DATA 10,168,169,0,153,0      :rem 94
3850 DATA 208,169,0,141,38,192   :rem 205
3860 DATA 160,12,153,1,208,96,256 :rem 93
```

Program 5: The Forbidden Crypt—Plus/4 And 16 Version

```
20 POKE55,0:POKE56,60:CLR:COLOR 0,1,0:COL
   OR4,1,0:COLOR1,7,4
30 DIMMN(4,6),DR(8),RM(4)
40 FORI=1TO4:FORJ=1TO6:READMN(I,J):NEXTJ:
   NEXTI:FORI=1TO8:READDR(I):NEXT
50 FORI=1TO4:RM(I)=1:NEXT
60 DATA0,77,78,40,79,72,0,82,83,1,84,69,0
   ,85,86,1,87,34,0,88,89,40,90,52
70 DATA-40,-39,1,41,40,39,-1,-41
80 DEFFNY(X)=INT(X/40):DEFFNX(X)=X-(FNY(X
   )*40)
90 PR=30
100 GOSUB1280:GOSUB1380
110 VOL 5
120 T$="{RVS}{40 SPACES}{OFF}"
130 S$="{RVS}{2 SPACES}{OFF}{36 SPACES}
    {RVS}{2 SPACES}{OFF}":P=5
140 DEFFNA(X)=INT(RND(1)*X)+1
150 DEFFNRX(X)=INT(RND(1)*100)+X:DEFFNRY(
    Y)=INT(RND(1)*58)+Y
160 PL=3572:PX=20:PY=12:OPL=PL
170 LV=1:SC=0:GOSUB330:END
180 PRINT"{CLR}";:PRINT:PRINTT$;S$;S$;:GO
    SUB200:PRINTS$;S$;:GOSUB200:PRINTS$;S
    $;T$
190 PRINT"{HOME}":RETURN
200 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}
    {A}**************{S}{2 SPACES}{A}*****
    ********{S}{2 SPACES}{RVS}{2 SPACES}
    {OFF}";
210 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}-
    {13 SPACES}-{2 SPACES}-{13 SPACES}-
    {2 SPACES}{RVS}{2 SPACES}{OFF}";
220 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}-
    {13 SPACES}-{2 SPACES}-{13 SPACES}-
    {2 SPACES}{RVS}{2 SPACES}{OFF}";
230 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}I
    {13 SPACES}I{2 SPACES}I{13 SPACES}I
    {2 SPACES}{RVS}{2 SPACES}{OFF}";
240 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}-
    {13 SPACES}-{2 SPACES}-{13 SPACES}-
    {2 SPACES}{RVS}{2 SPACES}{OFF}";
250 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}-
    {13 SPACES}-{2 SPACES}-{13 SPACES}-
    {2 SPACES}{RVS}{2 SPACES}{OFF}";
260 PRINT"{RVS}{2 SPACES}{OFF}{2 SPACES}
    {Z}**************{X}{2 SPACES}{Z}*****
    ********{X}{2 SPACES}{RVS}{2 SPACES}
    {OFF}";
270 RETURN
280 PRINT"{CLR}";:PRINT:PRINTT$;
290 FORI=1TO20:PRINTS$;:NEXT:PRINTT$:PRIN
    T"{HOME}":PRINT"{9 DOWN}";
300 D$="{L}{J}{36 SPACES}{L}{J}":PRINTD$;
    D$;D$;D$:RETURN
310 PRINT"{HOME}{23 DOWN}{YEL}{2 SPACES}S
    CORE"SC"{3 SPACES}LEVEL"LV"{3 SPACES}
    LIVES"P"{7}"
320 PRINT"{HOME}":RETURN
330 REM OUTSIDE ROOM
340 IFTC<>4THEN360
350 TC=0:FORI=1TO4:RM(I)=1:NEXT:LV=LV+1:G
    OSUB1030:IFLV/4=INT(LV/4)THENP=P+1
360 GOSUB180:GOSUB310:IFP=0THEN600
370 IFRM(1)=0THENPOKE3363,160
380 IFRM(2)=0THENPOKE3380,160
390 IFRM(3)=0THENPOKE3723,160
400 IFRM(4)=0THENPOKE3740,160
410 POKEPL,81:POKEPL-1024,4
420 D=DR(JOY(1)AND15)
430 IFD=0THEN420
440 PL=PL+D:IFPEEK(PL)<>32THEN470
450 SOUND1,200,1
460 POKEOPL-1024,0:POKEOPL,32:POKEPL-1024
    ,4:POKEPL,81:OPL=PL:GOTO420
470 IFPEEK(PL)<>9THENPL=OPL:GOTO420
480 PY=FNY(PL-3072):PX=FNX(PL-3072)
490 IFPY=7THENRM=1
500 IFPY=16THENRM=3
510 IFPX>19THENRM=RM+1
520 IFRM=1THENCL=6
530 IFRM=2THENCL=7
540 IFRM=3THENCL=5
550 IFRM=4THENCL=2
560 IFRM(RM)=0THENPL=PL-D:GOTO460
570 PX=FNX(PL-3072):PY=FNY(PL-3072):GOSUB
    640
580 REM
590 GOTO340
600 PRINT"{HOME}{7 DOWN}{16 RIGHT}{RVS}
    {YEL}GAME OVER{OFF}"
610 PRINT"{DOWN}{7 RIGHT}{RVS}PRESS ANY K
    EY TO PLAY AGAIN{7}{OFF}":POKE239,0
620 WAIT239,1
630 PRINT"{CLR}":RUN
640 GOSUB280:GOSUB310:IFPX=21ORPX=4THENPX
    =2:PY=11:GOTO660
650 PX=37:PY=11
660 GOSUB1050
670 PL=PX+3072+(PY*40):POKEPL,0:POKEPL-10
    24,2:OPL=PL
680 MT=MN(RM,2):MB=MN(RM,3):MP=MN(RM,4):M
    D=MN(RM,5):MC=MN(RM,6)
690 FORI=0TO3:X=FNA(35)+2:Y=FNA(18)+2:Z=3
    072+X+(Y*40):POKEZ+MP,MB:POKEZ,MT
700 POKEZ-1024,MC:POKEZ+MP-1024,MC:M(I)=Z
    :NEXTI
710 X=FNA(18)+1:Y=FNA(12)+1:Z=3072+X+(40*
    Y):IFPEEK(Z)<>32THEN710
720 TR=2+MT:TL=Z:POKETL,TR
730 FL=0:DOWHILEFL=0
740 D=DR(JOY(1)AND15):A=PEEK(PL+D)
750 IFD<>0THENDM=D
760 IFJOY(1)AND128THENGOSUB1130
770 IFA=32THEN810
780 IF(A=0)OR(A=160)THEN830
790 IFA=TRTHENSC=SC+300:RM(RM)=0:TC=TC+1:
    GOSUB310:GOSUB1270:GOTO810
800 FL=1:GOTO840
810 PL=PL+D:POKEOPL-1024,0:POKEOPL,32:POK
    EPL-1024,2:POKEPL,0:OPL=PL
820 SOUND1,100,1
830 TQ=MQ:GOSUB910:IFTQ<>MQTHENFL=1:A=0:F
    ORI=200TO0STEP-5:SOUND1,I,2:NEXT
840 LOOP
850 IFA>100THEN870
860 P=P-1:IFRM(RM)=0THENRM(RM)=1:SC=SC-30
    0:TC=TC-1
870 PX=FNX(PL-3072):IFRM>2THENPY=16:ELSEP
    Y=7
880 IFPX<20THENPX=-20*((RM=2)OR(RM=4))-3*
    ((RM=1)OR(RM=3)):GOTO900
890 PX=-19*((RM=1)OR(RM=3))-36*((RM=2)OR(
    RM=4))
900 PL=3072+PX+(PY*40):OPL=PL:RETURN
910 FORI=1TO4:MM=MM+1:IFMM=4THENMM=0
920 IFM(MM)<>0THENI=6
930 NEXT I
940 IFI=5THENRETURN
```

```
950 V1=PL-3072:Y1=FNY(V1):X1=FNX(V1):V=M(
    MM)-3072
960 Y=FNY(V):X=FNX(V):M=40*(Y>Y1)-40*(Y<Y
    1):M=M-1*(X<X1)+1*(X>X1):TM=M(MM)+M
970 Q=PEEK(TM):R=PEEK(TM+MP):IFQ=0ORQ=C1O
    RR=C1THENMQ=MQ+1:RETURN
980 IF(M<>MP)AND(M<>-MP)THEN990
981 IFM=MPTHENIF(R<>0)AND(R<>32)THENRETUR
    N
982 IFM=-MPTHENIF(Q<>0)AND(Q<>32)THENRETU
    RN
983 GOTO1000
990 IF(Q<>32)OR(R<>32)THENRETURN
1000 POKEM(MM),32:POKEM(MM)+MP,32:POKETM-
     1024,MC:POKETM+MP-1024,MC:POKETM,MT
1010 POKETM+MP,MB:M(MM)=TM
1020 RETURN
1030 PRINT"{CLR}{10 DOWN}{6 RIGHT}YOU HAV
     E ACHIEVED LEVEL "LV"!"
1040 FORW=1TO1000:NEXTW:RETURN
1050 IFPX=37THENGOTO1070
1060 A=3472:GOTO1080
1070 A=3510
1080 FORI=ATOA+120STEP40:POKEI,160:POKEI+
     1,160:NEXTI:RETURN
1090 D=JOY(1)
1100 IFD=0THENRETURN
1110 D=DR(D):RETURN
1120 REM FIRE
1130 MS=PL+DM:OMS=MS:PT=PL
1140 SD=900
1150 B=PEEK(MS)
1160 IF(B=160)OR(B=117)OR(B=118)OR(B=TR)T
     HEN1250
1170 PT=PT+1
1180 IFB=MBORB=MTTHEN1210
1190 SD=SD-10:SOUND1,SD,10
1200 POKEOMS-1024,0:POKEMS-1024,27:POKEMS
     ,PR:POKEOMS,32:OMS=MS:MS=MS+DM:GOTO1
     150
1210 SC=SC+10:GOSUB310
1220 FORI=0TO3
1230 IFM(I)=MSORM(I)+MP=MSTHENPOKEM(I),32
     :POKEM(I)+MP,32:M(I)=0
1240 NEXT
1250 IFPT<>PLTHENPOKEOMS,32:POKEOMS-1024,
     0
1260 RETURN
1270 FORI=100TO1000STEP50:SOUND1,I,2:NEXT
     :RETURN
1280 FORI=819TO869:READA:POKEI,A:NEXT
1290 SYS819
1300 POKE65298,PEEK(65298)AND251
1310 POKE65299,(PEEK(65299)AND3)OR(60)
1320 RETURN
1330 DATA169,0,133,55,169,60,133,56,160
1340 DATA0,185,0,208,153,0,60,200,152
1350 DATA208,246,185,0,209,153,0,61,200,1
     52,208,246,185,0,210,153,0
1360 DATA62,200,152,208,246,185,0,211,153
     ,0,63,200,152,208
1370 DATA246,96
1380 FORI=1TO14:READA:FORJ=15360+(A*8)TO1
     5360+(A*8)+7:READB:POKEJ,B:NEXT:NEXT
1390 RETURN
1400 DATA0,60,126,219,255,189,195,126,60
1410 DATA77,129,66,36,24,126,153,24,126
1420 DATA78,153,24,126,153,24,126,153,0
1430 DATA82,0,0,0,131,198,108,56,0
1440 DATA83,4,24,24,140,204,108,56,0
1450 DATA85,28,54,98,64,113,63,5,5
1460 DATA86,0,0,0,16,248,252,80,80
1470 DATA88,24,36,36,24,126,189,189,189
1480 DATA89,189,60,60,126,255,0,0,0
1490 DATA30,0,0,24,60,60,24,0,0
1500 DATA79,0,0,0,126,153,153,129,255
1510 DATA84,192,224,118,60,28,62,38,0
1520 DATA87,126,231,195,153,153,195,231,1
     26
1530 DATA90,60,24,24,24,60,126,126,60
```

Address File

(Article on page 60.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

```
10 L=12:SYS65517:A=PEEK(781):Q$=CHR$(13):
   IFA=40THENPOKE53281,15:L=200   :rem 241
20 DIMM$(L,6),N$(6):FORI=1TO6:READN$(I):N
   EXT                            :rem 93
30 DATALAST NAME,FIRST NAME,ADDRESS,CITY/
   STATE,ZIP CODE,TELEPHONE       :rem 248
40 PRINT"{CLR}{2 DOWN}{3 RIGHT}{RVS}{BLK}
   ADDRESS FILE"Q$"{2 DOWN}{RIGHT}1..RETR
   IEVE FILE"Q$"{DOWN}{RIGHT}2..ADD/START
    FILE"                         :rem 47
50 PRINT"{DOWN}{RIGHT}3..EDIT FILE"Q$"
   {DOWN}{RIGHT}4..DISPLAY FILE"Q$"{DOWN}
   {RIGHT}5..SAVE AND END"        :rem 55
60 INPUT"{2 DOWN}YOUR CHOICE";B:ONBGOSUB4
   50,70,130,240,450:GOTO40       :rem 182
70 N=N+1:PRINT"{CLR}RECORD #"N:FORJ=1TO6:
   PRINTQ$"{RIGHT}{RVS}{BLK}";N$(J);"
   {OFF}{BLU}":INPUTM$(N,J)       :rem 35
80 NEXTJ:PRINT"{DOWN} {RVS}N{OFF}EXT
   {RVS}D{OFF}ELETE {RVS}E{OFF}ND"
                                  :rem 194
90 GETA$:IFA$=""OR(A$<>"D"ANDA$<>"N"ANDA$
   <>"E")THEN90                   :rem 205
100 IFA$="N"THEN70                :rem 234
110 IFA$="E"THEN40                :rem 223
120 N=N-1:GOTO70                  :rem 164
130 GOSUB660:FORI=1TON:IFB$=M$(I,1)THEN15
    0                             :rem 18
140 NEXTI:PRINT"{CLR}{DOWN}"B$"{DOWN}IS N
    OT IN FILE.":GOSUB620:GOTO40  :rem 34
150 GOSUB650:PRINT"{DOWN}CHANGE WHAT:":FO
    RJ=1TO6:PRINT"{RIGHT}"J".."N$(J):NEXT
                                  :rem 43
160 PRINT"{2 RIGHT}7 ..DELETE ENTRY{DOWN}
    ":INPUT"YOUR CHOICE";J:IFJ<1ORJ>7THEN
    160                           :rem 190
170 IFJ=7THEN210                  :rem 167
180 PRINT"{CLR}{RVS}"M$(I,1)", "M$(I,2)
                                  :rem 80
190 PRINT"{DOWN}{RVS}{BLK}OLD "N$(J)" IS
    {BLU}":PRINTM$(I,J)Q$Q$"{RVS}{BLK}COR
    RECTED "N$(J)" IS{BLU}"       :rem 200
200 INPUTM$(I,J):GOSUB620:GOTO220:rem 252
210 FORA=ITON-1:FORJ=1TO6:M$(A,J)=M$(A+1,
    J):NEXTJ,A:N=N-1              :rem 168
220 PRINT"{CLR}{DOWN}{RIGHT}DO YOU WISH T
    O:"Q$"{DOWN}{RIGHT}1..CONTINUE EDITIN
    G"Q$"{DOWN}{RIGHT}2..RETURN TO MENU
    {2 DOWN}"                     :rem 250
```

```
230 INPUT"{RIGHT}YOUR CHOICE";B:ONBGOTO13
    0,40:GOTO230                    :rem 123
240 PRINT"{CLR}{BLK}{DOWN}WHICH DO YOU WA
    NT"Q$"{DOWN}{RIGHT}1..ALPHABETICAL"Q$
    "{DOWN}{RIGHT}2..INDIVIDUAL"    :rem 4
250 PRINT"{DOWN}{RIGHT}3..MENU{2 DOWN}":I
    NPUT"YOUR CHOICE";B:ONBGOTO260,410,40
    :GOTO250                        :rem 70
260 G=N:IFN=0THENPRINT"{DOWN}NO RECORDS I
    N FILE.":FORI=1TO2000:NEXT:GOTO40
                                    :rem 32
270 G=INT(G/2)                      :rem 1
280 IFG=0THEN380                    :rem 167
290 FORA=1TON-G                     :rem 150
300 IFM$(A,1)<=M$(A+G,1)THEN350     :rem 148
310 R$=M$(A,1):S$=M$(A,2):T$=M$(A,3):U$=M
    $(A,4):V$=M$(A,5):W$=M$(A,6)    :rem 70
320 FORJ=1TO6:M$(A,J)=M$(A+G,J):NEXT
                                    :rem 97
330 M$(A+G,1)=R$:M$(A+G,2)=S$:M$(A+G,3)=T
    $:M$(A+G,4)=U$:M$(A+G,5)=V$     :rem 43
340 M$(A+G,6)=W$:E=A                :rem 35
350 NEXTA                           :rem 24
360 IFE=0THEN270                    :rem 162
370 E=0:GOTO280                     :rem 89
380 PRINT"{CLR}":L=0:FORI=1TON:L=L+1:PRIN
    TM$(I,1)", "M$(I,2):IFL<>10THEN400
                                    :rem 225
390 L=0:GOSUB620:PRINT"{CLR}"       :rem 69
400 NEXTI:GOSUB620:GOTO240          :rem 119
410 GOSUB660:FORI=1TON:IFB$=M$(I,1)THEN44
    0                               :rem 21
420 NEXTI                           :rem 30
430 PRINT"{CLR}{2 DOWN}";B$:PRINT"{DOWN}I
    S NOT IN FILE":GOSUB620:GOTO240
                                    :rem 121
440 GOSUB650:GOSUB620:GOTO240       :rem 14
450 PRINT"{CLR}DISK OR CASSETTE (D/C)"
                                    :rem 44
460 GETE$:IF(E$<>"D"ANDE$<>"C")ORE$=""THE
    N460                            :rem 249
470 IFE$="D"THENF$="@0:ADDRESSES":F=1:GOT
    O490                            :rem 184
480 F$="ADDRESSES":F=0:G$=""        :rem 56
490 IFB=5THEN540                    :rem 168
500 IFF=1THENG$=",S,R"              :rem 240
510 OPEN1,1+7*F,8*F,F$+G$:GOSUB580
                                    :rem 127
520 INPUT#1,N:FORI=1TON:FORJ=1TO6:rem 112
530 INPUT#1,M$(I,J):NEXT:NEXT:GOSUB580:CL
    OSE1:GOSUB580:GOTO40            :rem 129
540 IFF=1THENG$=",S,W"              :rem 249
550 OPEN1,1+7*F,1+7*F,F$+G$:GOSUB580
                                    :rem 222
560 PRINT#1,N:FORI=1TON:FORJ=1TO6:rem 113
570 PRINT#1,M$(I,J):NEXT:NEXT:GOSUB580:CL
    OSE1:GOSUB580:END               :rem 188
580 IFF=0THENRETURN                 :rem 238
590 IFO=0THENOPEN15,8,15:O=1        :rem 157
600 INPUT#15,A,B$,C,D:IFATHENPRINTA,B$,C,
    D:STOP                          :rem 133
610 RETURN                          :rem 119
620 PRINT"{2 DOWN}{RVS}{BLK}ANY KEY TO CO
    NT'"                            :rem 252
630 GETA$:IFA$=""THEN630            :rem 85
640 RETURN                          :rem 122
650 PRINT"{CLR}{DOWN}"M$(I,1)", "M$(I,2)Q
    $M$(I,3)Q$M$(I,4)" "M$(I,5)Q$M$(I,6):
    RETURN                          :rem 188
660 PRINT"{CLR}{DOWN}{3 RIGHT}WHAT NAME D
    O YOU"Q$"{3 RIGHT}WANT (LAST NAME)?":
    INPUT"{2 DOWN}";B$:RETURN       :rem 103
```

Power BASIC: Color Swap

(Article on page 108.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: Color Swap—64 Version

```
10 REM *COLOR-SWAP 64*{3 SPACES}N IS ML C
   ODE, A IS ADDRESS, AND I DOES THE COUN
   TING.                            :rem 128
20 N=74:FORA=685TO690STEP5:FORI=0TO3:POKE
   A+I,N:NEXTI:POKEA+I,96:N=N-64:NEXTA
                                    :rem 113
30 CK=0:FORI=0TO9:X=PEEK(685+I):CK=CK+X:N
   EXT                              :rem 252
40 REM CK IS CHECKSUM AND X ONE OF ITS CO
   MPONENTS.                        :rem 139
50 IFCK<>528THENPRINT"{CLR} {DOWN}CHECK L
   INE 20 FOR ERRORS.":END          :rem 42
100 CK=0:FORA=702TO750:READN:POKEA,N:CK=C
    K+N:NEXTA                       :rem 145
110 IFCK<>5158THENPRINT"{CLR} {DOWN}CHECK
     LINES 702-750 FOR ERRORS.":END
                                    :rem 222
120 RA=49152:RA$=STR$(RA):L=LEN(RA$):RA$=
    RIGHT$(RA$,L-1):REM RA IS RELOC. ADR.
                                    :rem 228
130 CK=0:FORA=RATORA+392:READN:POKEA,N:CK
    =CK+N:NEXTA                     :rem 78
140 IFCK<>46713THENPRINT"{CLR} {DOWN}CHEC
    K LINES 49152-49542 FOR ERRORS.":END
                                    :rem 235
150 PRINT"{CLR} {DOWN}NOW POKE700,OC:POKE
    701,NC:SYS"RA$" TO{3 SPACES}SWAP COLO
    RS"                             :rem 37
160 PRINT:PRINT"{2 SPACES}WHERE OC IS THE
     COLOR CODE FOR THE OLD COLOR,"
                                    :rem 165
170 PRINT"{2 SPACES}AND NC IS THE CODE FO
    R THE NEW COLOR.":END           :rem 213
702 DATA 216,173,188,2,41,15        :rem 97
708 DATA 141,188,2,173,189,2        :rem 109
714 DATA 41,15,141,189,2,169        :rem 103
720 DATA 0,141,172,2,141,171        :rem 80
726 DATA 2,141,169,2,141,170        :rem 93
732 DATA 2,96,173,33,208,41         :rem 51
738 DATA 15,205,188,2,208,6         :rem 56
744 DATA 173,189,2,141,33,208       :rem 154
750 DATA 96                         :rem 37
49152 DATA 32,190,2,173,134,2       :rem 145
49158 DATA 41,15,205,188,2,208      :rem 208
49164 DATA 9,173,189,2,141,134      :rem 212
49170 DATA 2,32,190,2,173,32        :rem 94
49176 DATA 208,41,15,205,188,2      :rem 208
49182 DATA 208,9,173,189,2,141      :rem 214
49188 DATA 32,208,32,190,2,32       :rem 153
49194 DATA 222,2,32,190,2,173       :rem 149
49200 DATA 37,208,41,15,205,188     :rem 252
49206 DATA 2,208,6,173,189,2        :rem 108
49212 DATA 141,37,208,173,38,208    :rem 50
49218 DATA 41,15,205,188,2,208      :rem 205
```

```
49224 DATA 6,173,189,2,141,38     :rem 161
49230 DATA 208,160,0,185,39,208   :rem 253
49236 DATA 41,15,205,188,2,208    :rem 205
49242 DATA 6,173,189,2,153,39     :rem 165
49248 DATA 208,200,192,8,208,235   :rem 53
49254 DATA 32,190,2,173,17,208    :rem 204
49260 DATA 41,64,240,22,32,222    :rem 191
49266 DATA 2,173,36,208,41,15     :rem 156
49272 DATA 205,188,2,208,6,173    :rem 211
49278 DATA 189,2,141,36,208,24    :rem 215
49284 DATA 144,7,173,22,208,41    :rem 207
49290 DATA 16,240,37,169,255,141   :rem 55
49296 DATA 170,2,173,34,208,41    :rem 207
49302 DATA 15,205,188,2,208,6     :rem 152
49308 DATA 173,189,2,141,34,208     :rem 4
49314 DATA 173,35,208,41,15,205   :rem 250
49320 DATA 188,2,208,6,173,189    :rem 216
49326 DATA 2,141,35,208,173,17    :rem 203
49332 DATA 208,41,32,208,5,169    :rem 206
49338 DATA 255,141,169,2,173,0    :rem 208
49344 DATA 221,41,3,201,3,208     :rem 139
49350 DATA 4,162,0,134,254,201    :rem 190
49356 DATA 2,208,4,162,64,134     :rem 156
49362 DATA 254,201,1,208,4,162    :rem 196
49368 DATA 128,134,254,201,0,208   :rem 47
49374 DATA 4,162,192,134,254,173   :rem 56
49380 DATA 24,208,41,240,32,173   :rem 249
49386 DATA 2,32,180,2,101,254     :rem 147
49392 DATA 133,254,169,0,133,253   :rem 52
49398 DATA 169,0,133,251,169,216   :rem 63
49404 DATA 133,252,162,0,142,167   :rem 41
49410 DATA 2,162,0,142,168,2       :rem 91
49416 DATA 162,234,142,183,2,160   :rem 44
49422 DATA 0,177,251,41,15,205    :rem 196
49428 DATA 188,2,208,5,173,189    :rem 224
49434 DATA 2,145,251,173,169,2    :rem 207
49440 DATA 201,255,208,2,240,55   :rem 246
49446 DATA 177,253,41,15,141,171   :rem 52
49452 DATA 2,205,188,2,208,6      :rem 106
49458 DATA 173,189,2,141,171,2    :rem 212
49464 DATA 177,253,41,240,141,172:rem 101
49470 DATA 2,32,173,2,205,188     :rem 154
49476 DATA 2,208,13,173,189,2     :rem 163
49482 DATA 32,178,2,24,109,171    :rem 209
49488 DATA 2,24,144,7,173,172     :rem 164
49494 DATA 2,24,109,171,2,145     :rem 155
49500 DATA 253,200,204,168,2,240   :rem 33
49506 DATA 2,208,170,174,183,2    :rem 204
49512 DATA 224,96,208,1,96,238    :rem 217
49518 DATA 167,2,230,252,230,254   :rem 47
49524 DATA 162,3,236,167,2,240    :rem 203
49530 DATA 2,208,144,162,232,142   :rem 39
49536 DATA 168,2,162,96,142,183    :rem 13
49542 DATA 2,208,132              :rem 220
```

Program 2: Color Swap—VIC Version

```
10 HT=PEEK(644):LT=PEEK(643):PRINT"{CLR}I
   F YOU ARE A CASSETTE USER, PRESS {RVS}
   C{OFF}."                          :rem 36
20 MT=HT*256+LT:MT=MT-183:HT=INT(MT/256):
   LT=MT-HT*256:PRINT"{DOWN}OTHERWISE, PR
   ESS {RVS}D{OFF}."                :rem 153
30 GETR$                            :rem 185
40 IFR$="D"THENRA=828:GOTO80        :rem 170
50 IFR$="C"THENPOKE55,LT:POKE56,HT:CLR:RA
   =PEEK(56)*256+PEEK(55):GOTO80    :rem 17
60 GOTO30                           :rem 2
70 REM *COLOR-SWAP VIC-20*{2 SPACES}N IS
   {SPACE}ML CODE, A IS ADDRESS, AND I DO
   ES THE COUNTING.                 :rem 141
80 N=74:FORA=680TO685STEP5:FORI=0TO3:POKE
   A+I,N:NEXTI:POKEA+I,96:N=N-64:NEXTA
                                    :rem 118
90 CK=0:FORI=0TO9:X=PEEK(680+I):CK=CK+X:N
   EXT                              :rem 253
100 REM CK IS CHECKSUM AND X ONE OF ITS C
    OMPONENTS.                      :rem 184
110 IFCK<>528THENPRINT"{CLR}{2 SPACES}
    {DOWN}CHECK LINE 80 FOR{6 SPACES}ERRO
    RS.":END                        :rem 93
120 RA=RA:RA$=STR$(RA):L=LEN(RA$):RA$=RIG
    HT$(RA$,L-1):REM RA IS RELOCATABLE AD
    R.                              :rem 237
130 CK=0:FORA=RATORA+182:READN:POKEA,N:CK
    =CK+N:NEXTA                     :rem 75
140 IFCK<>19910THENPRINT"{CLR} {DOWN}CHEC
    K LINES 828-1008":PRINT" FOR ERRORS."
    :END                            :rem 83
150 PRINT"{CLR} {DOWN}NOW-":PRINT:PRINT"P
    OKE 700,OC:POKE701,NC":PRINT"SYS"RA$:
    PRINT:PRINT                     :rem 143
160 PRINT"{3 SPACES}WHERE OC IS OLD
    {5 SPACES}COLOR CODE,":PRINT"
    {3 SPACES}AND NC IS THE NEW{3 SPACES}
    COLOR."                         :rem 57
170 END                            :rem 111
828 DATA 173, 134, 2, 41, 15, 205 :rem 95
834 DATA 188, 2, 208, 6, 173, 189:rem 117
840 DATA 2, 141, 134, 2, 173, 14  :rem 36
846 DATA 144, 41, 15, 141, 19, 3  :rem 47
852 DATA 173, 14, 144, 32, 168, 2:rem 100
858 DATA 205, 188, 2, 208, 12, 173
                                  :rem 157
864 DATA 189, 2, 32, 173, 2, 109  :rem 56
870 DATA 19, 3, 141, 14, 144, 173 :rem 97
876 DATA 15, 144, 41, 240, 141, 16
                                  :rem 146
882 DATA 3, 32, 168, 2, 141, 17   :rem 255
888 DATA 3, 205, 188, 2, 208, 12  :rem 56
894 DATA 173, 189, 2, 141, 17, 3  :rem 59
900 DATA 32, 173, 2, 141, 16, 3  :rem 241
906 DATA 173, 15, 144, 41, 8, 141 :rem 98
912 DATA 19, 3, 173, 15, 144, 41  :rem 46
918 DATA 7, 141, 18, 3, 205, 188  :rem 57
924 DATA 2, 208, 6, 173, 189, 2     :rem 6
930 DATA 141, 18, 3, 13, 19, 3    :rem 197
936 DATA 13, 16, 3, 141, 15, 144  :rem 43
942 DATA 169, 0, 168, 170, 133, 251
                                  :rem 203
948 DATA 173, 2, 144, 41, 128, 208
                                  :rem 155
954 DATA 6, 169, 148, 133, 252, 208
                                  :rem 213
960 DATA 4, 169, 150, 133, 252, 177
                                  :rem 206
966 DATA 251, 41, 15, 205, 188, 2:rem 104
972 DATA 208, 5, 173, 189, 2, 145:rem 112
978 DATA 251, 200, 208, 239, 230, 252
                                  :rem 46
984 DATA 232, 224, 1, 208, 232, 177
                                  :rem 203
990 DATA 251, 41, 15, 205, 188, 2:rem 101
996 DATA 208, 5, 173, 189, 2, 145:rem 118
1002 DATA 251, 200, 192, 251, 240, 2
                                  :rem 223
1008 DATA 208, 235, 96            :rem 222
```

Program 3: VIC Inverter

```
10 REM *VIC INVERTER* CK IS CHECKSUM, A I
   S ADDRESS, AND N IS ML CODE.    :rem 65
20 RA=743:RA$=STR$(RA):L=LEN(RA$):RA$=RIG
   HT$(RA$,L-1):REM RA IS RELOCATABLE ADD
   RESS.                           :rem 246
30 CK=0:FORA=RATORA+24:READN:POKEA+I,N:CK
   =CK+N:NEXTA                     :rem 89
40 IFCK<>2391THENPRINT"{CLR}{DOWN}"SPC(3)
   "CHECK YOUR DATA"SPC(9)"STATEMENTS.":E
   ND                              :rem 222
50 PRINT"{CLR} {DOWN}NOW SYS"RA$" TO TURN
   ":PRINT:PRINT" INVERSE ON AND OFF.":EN
   D                               :rem 44
743 DATA 173, 15, 144, 41, 8, 240 :rem 97
749 DATA 9, 173, 15, 144, 41, 247:rem 111
755 DATA 141, 15, 144, 96, 173, 15
                                   :rem 156
761 DATA 144, 9, 8, 141, 15, 144  :rem 51
767 DATA 96                       :rem 45
```

Name That Note

(Article on page 62.)

> BEFORE TYPING . . .
>
> Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: Name That Note—VIC Version

```
0 PRINT"{CLR}";CHR$(142):POKE36879,59
                                   :rem 204
1 PRINT"{HOME}{3 DOWN}{RIGHT}{BLK}CCCCCCC
  CCCCCCCCCCCCCC{2 RIGHT}CCCNAME THAT NOTE
  CCC{2 RIGHT}CCCCCCCCCCCCCCCCCCCCC"
                                   :rem 251
2 PRINT"{RIGHT}CCCCCCCCCCCCCCCCCCCC
  {2 RIGHT}CCCCCCCCCCCCCCCCCCCC{RIGHT}
  {2 DOWN}{4 RIGHT}A MUSIC TUTOR :rem 195
3 PRINT"{6 DOWN}{4 RIGHT}INSTRUCTIONS?
  {13 RIGHT}Y=YES":C$=CHR$(13)    :rem 102
4 GETI$:IFI$=""THEN4              :rem 155
5 IFI$<>"Y"THENGOTO14             :rem 21
6 PRINT"{CLR}";CHR$(14)"{4 RIGHT}{BLK}NAM
  E THAT NOTE{4 SPACES}{3 RIGHT}{16 T}",
  {5 RIGHT}INSTRUCTIONS"          :rem 153
7 PRINT"{RVS}1{OFF} LEARN THE POSITION","
  {2 RIGHT}OF THE NOTES IN THE","
  {2 RIGHT}STAVES."               :rem 244
8 PRINT"{RVS}2{OFF} LEARN THE CLEF SIGN",
  "{2 RIGHT}(PITCH RANGE)OF THE","
  {2 RIGHT}STAVES(TREBLE CLEF"    :rem 83
9 PRINT"{2 RIGHT}OR G-CLEF.BASS CLEF","
  {2 RIGHT}OR F-CLEF)","{RVS}3{OFF} START
   THE EXERCISE","{2 RIGHT}BY CHOOSING";
                                   :rem 205
10 PRINT" A PITCH"C$"{2 RIGHT}RANGE."C$"
   {RVS}4{OFF} PROMPTLY RECOGNIZE","
   {2 RIGHT}THE NOTE DISPLAYED"   :rem 251
11 PRINT"{2 RIGHT}IN THE STAFF-PRESS"C$"
   {2 RIGHT}THE CORRESPONDING","{2 RIGHT}
   KEY.";                         :rem 178
12 PRINT"THE QUICKER THE {2 RIGHT}BETTER.
   "C$"{RVS} PRESS A KEY TO GO ON {OFF}
   {CYN}"                         :rem 51
13 GETP$:IFP$=""THEN13            :rem 9
14 POKE1,17:POKE2,18:GOTO810      :rem 149
18 POKE36879,109:PRINTCHR$(147):PRINT"
   {WHT}{10 DOWN}{5 RIGHT}PLEASE WAIT
   {BLU}"                         :rem 125
19 POKE36869,255:POKE56,28:CLR:FORI=7168T
   O7679:POKEI,PEEK(I+25600):NEXT :rem 49
20 FORI=0TO7:POKE7168+I,PEEK(33464+I):NEX
   T:FORI=0TO7:READX:POKE7384+I,X:NEXT
                                   :rem 46
50 DATA0,0,0,0,0,60,66,66,66,66,60,0,0,0,
   0,255,0,60,66,66,66,66,60,255 :rem 131
51 DATA60,126,227,193,129,129,129,255,129
   ,131,135,142,156,184,240,255,224,192
                                   :rem 19
52 DATA128,128,128,128,128,255,128,240,24
   8,140,134,131,129,255,129,129,129,130,
   132,136                        :rem 201
53 DATA144,255,128,128,128,128,128,128,0,
   0,0,0,0,32,112,112,97,62,128,128,64,32
   ,16,8,4                        :rem 166
54 DATA255,96,195,135,136,136,132,128,255
   ,1,7,12,24,48,96,96,255        :rem 158
55 DATA0,0,0,24,24,0,0,255,240,56,12,6,3,
   131,195,255,195,131,3,3        :rem 87
56 DATA3,3,3,255,3,3,6,12,24,48,96,255,33
   ,30,0,0,0,0,0,0,255,1,2,4,8,8,5,2,255,3,
   1,0,0,0                        :rem 105
58 DATA0,0,255                    :rem 219
60 FORI=0TO7:READX:POKE7392+I,X:POKE7400+
   I,PEEK(33568+I):NEXT           :rem 1
75 FORI=7408TO7423:READX:POKEI,X:NEXT:FOR
   I=7432TO7551:READX:POKEI,X:NEXT
                                   :rem 197
80 FORI=7632TO7639:READX:POKEI,X:NEXT
                                   :rem 128
81 POKE1,81:POKE2,84:GOTO810      :rem 157
84 POKE36879,24:POKE36869,255     :rem 127
90 DATA158,161,173,181,189,192,200,206,20
   8,214,218,222,224,227,230,231,234,236
                                   :rem 54
100 PRINTCHR$(147):FORI=7724TO7724+109:PO
    KEI,29:NEXT                   :rem 133
101 FORI=7878TO7878+109:POKEI,29:NEXT
                                   :rem 229
102 POKE7726,31:POKE7748,33:POKE7770,34:P
    OKE7792,35:POKE7814,36:POKE7836,37
                                   :rem 77
103 POKE7835,38:POKE7813,39:POKE7791,40:P
    OKE7769,41:POKE7902,42         :rem 122
105 POKE7924,42:POKE7901,43:POKE7923,44:P
    OKE7945,45:POKE7966,46:POKE7900,47
                                   :rem 78
110 PRINT"{HOME}{21 DOWN}{GRN}&{PUR}&
    {BLK}&{BLU}&{BLK}NAME THAT NOTE{BLK}&
    {PUR}&{GRN}&{CYN}&{BLK}{HOME}":rem 24
120 PRINT"{16 DOWN}{3 RIGHT}{BLK}ENTER CL
    EF SIGN":PRINT"{3 RIGHT}T=TREBLE B=BA
    SS":GOSUB500                   :rem 204
200 R=0:DIMP(18):DIMN(18):FORI=0TO18STEP2
    :P(I)=7685+R:R=R+22:NEXT       :rem 183
202 DIMN1(20):V=36878:S2=36875:FORN=20TO3
    STEP-1:READN1(N):NEXTN         :rem 63
203 N(0)=68:FORH=1TO18:N(H)=(N(H-1)-1)+(7
    *-(N(H-1)=65)):NEXT            :rem 5
```

```
205 PRINT"{3 UP}":FORE=0TO40:PRINTCHR$(32
    );:NEXT:PRINT"{HOME}{22 SPACES}"
                                    :rem 69
206 GOSUB400:C=5:SC=0:Q=L*22:FORI=38400TO
    38839:POKEI,0:NEXT              :rem 89
208 FORI=0TO15STEP5                 :rem 177
210 J=INT(RND(X)*13)+3:J1=J:E=29:E1=30:E2
    =27:E3=28                       :rem 50
212 PRINT"{HOME}{5 RIGHT}{BLK}SCORE{BLK}"
    SC                              :rem 60
225 IFJ1=INT(J1/2)*2THENPOKEP(J1)+I+Q,E1:
    GOTO232                         :rem 106
230 POKEP(J1-1)+I+Q,E2:POKEP(J1+1)+I+Q,E3
    :POKEP(J1-1)-1+I+Q,E:POKEP(J1-1)+1+I+
    Q,E                             :rem 136
232 IFE1=29ORE1=32THEN260           :rem 196
235 T=TI                            :rem 200
240 GETN$:IFN$=""THENIFTI-T<600THEN240
                                    :rem 23
241 IFN$=""THEN250                  :rem 223
242 IFASC(N$)<65THENN$="":GOTO250:rem 148
243 POKE8059+I,ASC(N$)-64:IFASC(N$)=N(J1+
    Z)THEN300                       :rem 112
250 FORT=0TO500:NEXTT:IFJ1=3THENE=32:E1=3
    2:E2=32:E3=29                   :rem 13
252 IFJ1=13THENE1=32:E2=29:E3=32    :rem 56
253 IFJ1=14ORJ1=15THENE=32:E1=32:E2=32:E3
    =32                             :rem 20
254 IFJ1>3ANDJ1<13THENE1=29:E2=29:E3=29
                                    :rem 4
256 POKE8059+I,32:POKE38779+I,0:GOTO225
                                    :rem 254
260 NEXTI                           :rem 32
270 C=C-1:IFC>0THEN208              :rem 253
272 IFSC>SITHENSI=SC                :rem 56
275 PRINT"{HOME}{BLK}SCORE{BLK}"SC"{LEFT}
    {3 SPACES}HI{BLK}"SI            :rem 82
285 PRINT"{HOME}{17 DOWN}{RIGHT}AGAIN?T=T
    REBLE B=BASS":GOSUB500:GOTO205
                                    :rem 176
300 POKE38779+I,0:SC=SC+(600-(TI-T))
                                    :rem 245
310 IFJ1>2ANDJ1<16THENPOKEV,15:POKES2+X,N
    1(J1+X1):FORS=0TO150:NEXTS:POKES2+X,0
    :POKEV,0                        :rem 175
320 GOTO250                         :rem 101
400 POKEV,15:F=15:G=8:K=-1:GOSUB430
                                    :rem 53
410 F=8:G=15:K=1:GOSUB430           :rem 184
420 POKES2+X,0:RETURN               :rem 67
430 FORP=FTOGSTEPK:POKES2+X,N1(P):FORI=0T
    O200:NEXTI:POKES2+X,0:FORS=1TO20:NEXT
    S:NEXTP                         :rem 150
440 RETURN                          :rem 120
500 GETA$:IFA$=""THEN500            :rem 77
510 IFA$="T"THENL=0:Z=0:X=1:X1=0:RETURN
                                    :rem 146
520 IFA$="B"THENL=7:Z=-2:X=0:X1=5:RETURN
                                    :rem 187
530 PRINTCHR$(147):END              :rem 36
810 RE=830:DE=DE+1:POKE0,DE:PRINTDE
                                    :rem 139
820 PRINT"GO"RE:FORBK=631TO634:POKEBK,145
    :NEXT:POKE635,13:POKE636,13:POKE198,6
    :END                            :rem 191
830 PRINTCHR$(147):DE=PEEK(0):DR=PEEK(1):
    IFDE<DRTHEN810                  :rem 92
840 RE=PEEK(2):GOTO820              :rem 37
```

Program 2: Name That Note—64 Version

```
100 DIM LOW%(25),HI%(25)            :rem 212
110 PRINT"{BLK}{CLR}{13 DOWN}{12 RIGHT}JU
    ST A SECOND..."                 :rem 140
120 POKE53281,12:POKE53280,12       :rem 78
130 REM INITIIALIZE ROUTINE         :rem 217
140 NO$ = "EFGABCDEFGABCDEFGABCDEFGA"
                                    :rem 126
150 FOR T= 1 TO 25:READ LOW%(T):NEXT:FOR
    {SPACE}T=1TO25:READ HI%(T):NEXT
                                    :rem 235
160 FOR T=0 TO 63:READD:POKE704+T,D:NEXT:
    POKE2040,11                     :rem 14
170 FOR T= 832TO1020:READD:POKET,D:NEXT:P
    OKE2041,13:POKE2042,14          :rem 213
180 POKE2043,15                     :rem 35
190 V= 53248:POKEV+21,0             :rem 220
200 POKEV,255:POKEV+16,0:POKEV+39,0:POKE5
    3280,12:POKE53281,12            :rem 51
210 POKEV+2,90:POKEV+3,84:POKEV+4,88:POKE
    V+5,126:POKEV+23,14:POKEV+29,14
                                    :rem 35
220 POKEV+6,90:POKEV+7,163:POKEV+40,0:POK
    EV+41,0:POKEV+42,0              :rem 247
230 S=54272:FOR T= S TO S+24:POKET,0:NEXT
                                    :rem 71
240 POKES+24,13:POKES+5,17:POKES+6,243
                                    :rem 203
250 PRINT"{CLR}{10 DOWN}{13 RIGHT}NAME TH
    AT NOTE":FORT=6TO 20:POKES,LOW%(T)
                                    :rem 55
260 POKES+1,HI%(T):POKES+4,17:FOR T1= 1TO
    150:NEXT:POKES+4,16             :rem 32
270 FOR T2=1TO40:NEXT:NEXT          :rem 109
280 CH$="":PRINT"{2 DOWN}{4 RIGHT}DO YOU
    {SPACE}WANT {RVS}T{OFF}REBLE, {RVS}B
    {OFF}ASS OR {RVS}A{OFF}LL":INPUT "
    {4 RIGHT}";CH$                  :rem 26
290 IF CH$<>"B"ANDCH$<>"T"AND CH$<>"A"THE
    N PRINT"{5 UP}" :GOTO280        :rem 208
300 LW=-(CH$="B"ORCH$="A")-(CH$="T")*13
                                    :rem 5
310 TP=-(CH$="B")*13-(CH$="T"ORCH$="A")*2
    5                               :rem 152
320 POKE646,6:PRINT"{CLR}{6 DOWN}"
                                    :rem 202
330 LI$="**********************************
    **":FOR T= 1 TO 5:PRINTSPC(3)LI$:NEXT
                                    :rem 110
340 PRINT"{DOWN}"                   :rem 121
350 FOR T= 1 TO 5:PRINTSPC(3)LI$:NEXT
                                    :rem 124
360 PRINT"{HOME}COUNTER{7 RIGHT}SCORE
    {7 RIGHT}MISSES"                :rem 131
370 FOR TR= 1 TO 20                 :rem 154
380 NN=INT(RND(0)*(TP-LW)+LW):IFNN=NO THE
    N 380                           :rem 219
390 POKES,LOW%(NN):POKES+1,HI%(NN):rem 53
400 IF NN=1ORNN=25ORNN=13THEN POKE 752,12
    7:POKE754,240:GOTO420           :rem 130
410 POKE752,1:POKE754,0             :rem 36
420 POKE V+1,(194-4*NN)+8*(NN>13):POKEV+2
    1,15                            :rem 180
430 TS=10                           :rem 220
440 FOR T=0TO 500:NEXT:TS=TS-1:PRINT"
    {HOME}{9 RIGHT}";TS:GET G$      :rem 158
450 IF G$<>""THENPOKE1934,(ASC(G$)-64)AND
    255                             :rem 150
```

```
460 IF(G$<>""AND G$<>MID$(NO$,NN,1))ORTS=
    0THENWR=WR+1:POKE198,0          :rem 198
470 PRINT"{HOME}{33 RIGHT}";WR      :rem 32
480 IFG$<>MID$(NO$,NN,1)ANDTS<>0THEN440
                                    :rem 48
485 IF TS<>0THENPOKES+4,17:FORT=1TO300:NE
    XT:POKES+4,16                   :rem 101
490 SC=SC+TS:PRINT"{HOME}{20 RIGHT}";SC;
                                    :rem 70
500 FOR T= 0 TO 1500:NEXT           :rem 31
510 NO=NN:NEXT                      :rem 133
520 POKEV+21,0:PRINT"{CLR}{11 RIGHT}
    {7 DOWN}YOUR SCORE WAS";SC      :rem 225
530 PRINT"{3 DOWN}{9 RIGHT}AND YOU MISSED
    ";WR;"TIME(S)"                  :rem 108
540 PRINT"{3 DOWN}{6 RIGHT}WOULD YOU LIKE
     TO PLAY AGAIN?"                :rem 112
550 GET A$:IF A$=""THEN550          :rem 87
560 IF A$<>"Y"ANDA$<>"N"THEN550     :rem 179
570 IF A$="Y"THEN RUN               :rem 142
580 REM DATA NOTES (LOW BYTES)      :rem 238
590 DATA 71,152,71,12,233,97,104,143,48,1
    43,24,210                       :rem 153
600 DATA 195,209,31,96,30,49,165,135,162,
    62,193,60,99                    :rem 72
610 REM DATA NOTES (HIGH BYTES)     :rem 22
620 DATA 5,5,6,7,7,8,9,10,11,12,14,15
                                    :rem 6
630 DATA 16,18,21,22,25,28,31,33,37,42,44
    ,50,56                          :rem 253
640 REM DATA FOR SPRITE             :rem 86
650 DATA000,002,000,000,003,000,000,002
                                    :rem 112
660 DATA128,000,002,064,000,002,032,000
                                    :rem 136
670 DATA002,032,000,002,032,000,002,064
                                    :rem 133
680 DATA000,002,000,000,002,000,000,002
                                    :rem 114
690 DATA000,000,002,000,000,002,000,000
                                    :rem 113
700 DATA122,000,000,254,000,001,254,000
                                    :rem 129
710 DATA001,254,000,001,254,000,000,252
                                    :rem 135
720 DATA000,000,120,000,000,000,000,000
                                    :rem 106
730 DATA0,224,0,0,208,0,0,216,0,0,204,0,0
                                    :rem 213
740 DATA206,0,0,199,0,0,199,0,0,199,0,0,2
    06,0                            :rem 186
750 DATA0,204,0,0,216,0,0,240,0,0,224,0,1
                                    :rem 212
760 DATA192,0,3,192,0,6,192,0,12,192,0,24
    ,192                            :rem 197
770 DATA0,48,192,0,96,192,0,224,192,0,255
                                    :rem 19
780 DATA48,111,128,97,248,192,195,96,96,1
    98,96,48,195,104,48,193         :rem 200
790 DATA232,48,96,248,96            :rem 233
800 DATA112,96,224,56,96,192,28,99,192,7
                                    :rem 254
810 DATA111,0,1,248,0,0,96,0,0,0,0,0,0,0,
    0,0,0                           :rem 180
820 DATA0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
                                    :rem 72
830 DATA 0,248,0,3,6,0,6,3,128,6,0,198,3,
    192                             :rem 99
840 DATA 198,3,192,192,0,0,198,0,1,134,0,
    1                               :rem 3
850 DATA128,0,3,0,0,3,0,0,6,0,0,12,0,0
                                    :rem 61
860 DATA24,0,0,112,0,1,192,0,3,0,0,0,0,0,
    0,0,0                           :rem 178
870 DATA0,0,0,0,0,0                 :rem 181
```

Program 3: Name That Note—Plus/4 And 16 Version

```
10 FORI=1TO210:READA:X=X+A:NEXT:IFX<>2886
   0THENPRINT"ERROR IN DATA STATEMENTS.":
   STOP
20 POKE56,60:POKE55,0:CLR:VOL 8
30 FORI=819TO848:READA:POKEI,A:NEXT
40 DATA160,0,185,0,208,153,0,60,185,0,209
   ,153,0,61
50 DATA185,0,210,153,0,62,185,0,211,153,0
   ,63,136,208,229,96
60 PRINT"{CLR}"CHR$(142):COLOR0,4,1:COLOR
   4,4:F$="CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
   CCCCCCCCC"
70 C$=CHR$(13):PRINT"{HOME}{4 DOWN}{WHT}"
   F$"CCCCCCCCCCCCCCNAME THAT NOTECCCCCCC
   CCCCCCCC"F$F$
80 PRINT"{3 DOWN}"TAB(13)"A MUSIC TUTOR"
90 PRINT"{9 DOWN}"TAB(13)"INSTRUCTIONS?"C
   $TAB(16)"{RVS}Y{OFF}ES/{RVS}N{OFF}O"
100 GETKEYI$:IFI$<>"Y"THEN200
110 PRINT"{CLR}{DOWN}"CHR$(14)TAB(13)"NAM
    E THAT NOTE"C$TAB(12)"{16 T}"
120 PRINTTAB(14)"{DOWN}INSTRUCTIONS"
130 PRINT"{DOWN}{RVS}1{OFF} LEARN THE POS
    ITION OF THE NOTES IN THE":PRINT"
    {2 RIGHT}STAVES."
140 PRINT"{DOWN}{RVS}2{OFF} LEARN THE CLE
    F SIGN (PITCH RANGE) OF"C$"{2 RIGHT}T
    HE STAVES (TREBLE CLEF";
150 PRINT" OR G-CLEF."C$"{2 RIGHT}BASS CL
    EF OR F-CLEF)."
160 PRINT"{DOWN}{RVS}3{OFF} START THE EXE
    RCISE BY CHOOSING A PITCH{2 RIGHT}RAN
    GE."
170 PRINT"{DOWN}{RVS}4{OFF} PROMPTLY RECO
    GNIZE THE NOTE DISPLAYED"
180 PRINT"{2 RIGHT}IN THE STAFF -
    {SHIFT-SPACE}PRESS THE CORRESPONDING"
    ;:PRINT"{2 RIGHT}KEY.";
190 PRINT"{RIGHT}THE QUICKER, THE BETTER.
    "C$TAB(9)"{3 DOWN}{RVS} PRESS A KEY T
    O GO ON {OFF}{CYN}":GETKEYP$
200 COLOR0,7:COLOR4,7:PRINTCHR$(147):PRIN
    T"{BLU}{10 DOWN}"TAB(14)"PLEASE WAIT
    {BLK}":SYS819
210 FORI=0TO7:POKE15360+I,PEEK(16056+I):N
    EXT:FORI=0TO7:READX:POKE15576+I,X:NEX
    T
220 DATA0,0,0,0,0,60,66,66,66,66,60,0,0,0
    ,0,255,0,60,66,66,66,66,60,255
230 DATA60,126,227,193,129,129,129,255,12
    9,131,135,142,156,184,240,255,224,192
240 DATA128,128,128,128,128,255,128,240,2
    48,140,134,131,129,255,129,129,129,13
    0,132,136
250 DATA144,255,128,128,128,128,128,128,0
    ,0,0,0,0,32,112,112,97,62,128,128,64,
    32,16,8,4
260 DATA255,96,195,135,136,136,132,128,25
    5,1,7,12,24,48,96,96,255
270 DATA0,0,0,24,24,0,0,255,240,56,12,6,3
    ,131,195,255,195,131,3,3
```

```
280 DATA3,3,3,255,3,3,6,12,24,48,96,255,3
    3,30,0,0,0,0,0,255,1,2,4,8,8,5,2,255,
    3,1,0,0,0
290 DATA0,0,255
300 FORI=0TO7:READX:POKE15584+I,X:POKE155
    92+I,PEEK(16160+I):NEXT
310 FORI=15600TO15615:READX:POKEI,X:NEXT:
    FORI=15624TO15743:READX:POKEI,X:NEXT
320 FORI=15824TO15831:READX:POKEI,X:NEXT
330 COLOR0,2:COLOR4,5:POKE65298,PEEK(6529
    8)AND251
340 POKE65299,PEEK(65299)AND3OR60
350 DATA7,118,169,262,345,383,453,516,571
    ,596,643
360 DATA685,704,739,770,798,810,834,854,8
    64,881,897
370 PRINTCHR$(147):FORI=3152TO3351:POKEI,
    29:NEXT
380 FORI=3432TO3631:POKEI,29:NEXT
390 POKE3155,31:POKE3195,33:POKE3235,34:P
    OKE3275,35:POKE3315,36:POKE3355,37
400 POKE3354,38:POKE3314,39:POKE3274,40:P
    OKE3234,41:POKE3475,42
410 POKE3515,42:POKE3474,43:POKE3514,44:P
    OKE3554,45:POKE3593,46:POKE3473,47
420 PRINT"{HOME}{22 DOWN}{GRN}"TAB(9)"&
    {PUR}&{BLK}&{BLU}&{BLK}NAME THAT NOTE
    {BLK}&{PUR}&{GRN}&{CYN}&{HOME}"
430 PRINT"{16 DOWN}"TAB(12)"{BLK}ENTER CL
    EF SIGN{DOWN}"
440 PRINTTAB(12)"{RVS}T{OFF}=TREBLE {RVS}
    B{OFF}=BASS":GOSUB770
450 R=0:DIMP(18):DIMN(18):FORI=0TO18STEP2
    :P(I)=3079+R:R=R+40:NEXT
460 DIMN1(24):FORN=24TO3STEP-1:READN1(N):
    NEXTN
470 N(0)=68:FORH=1TO18:N(H)=(N(H-1)-1)+(7
    *-(N(H-1)=65)):NEXT
480 FORI=3761TO3782:POKEI,32:POKEI+80,32:
    NEXT
490 GOSUB740:C=5:SC=0:Q=L*40:FORI=2048TO2
    846:POKEI,0:NEXT
500 FORI=0TO30STEP10
510 J=INT(RND(X)*13)+3:IFJ=OJOR(L=7ANDJ>1
    2)THEN510
520 OJ=J:J1=J:E=29:E1=30:E2=27:E3=28:PRIN
    T"{HOME}"TAB(5)"{RVS}{RED}SCORE{OFF}
    {BLK}"SC
530 PRINT"{HOME}"TAB(26)"{RVS}{PUR}COUNTE
    R{OFF}{BLK}"9:IFJ1=INT(J1/2)*2THENPOK
    EP(J1)+I+Q,E1:GOTO550
540 POKEP(J1-1)+I+Q,E2:POKEP(J1+1)+I+Q,E3
    :POKEP(J1-1)-1+I+Q,E:POKEP(J1-1)+1+I+
    Q,E
550 IFE1=29ORE1=32THEN660
560 TI$="000000":POKE239,0
570 GETN$:IFN$=""THENT=TI:IFT<600THENPRIN
    T"{HOME}"TAB(33)9-INT(T/60):GOTO570
580 IFN$=""THEN610
590 IFASC(N$)<65THENN$="":GOTO610
600 POKE3759+I,ASC(N$)-64:IFASC(N$)=N(J1+
    Z)THEN710
610 FORT=0TO500:NEXTT:IFJ1=3THENE=32:E1=3
    2:E2=32:E3=29
620 IFJ1=13THENE1=32:E2=29:E3=32
630 IFJ1=14ORJ1=15THENE=32:E1=32:E2=32:E3
    =32
640 IFJ1>3ANDJ1<13THENE1=29:E2=29:E3=29
650 POKE3759+I,32:GOTO530
660 NEXTI
670 C=C-1:IFC>0THEN500
680 IFSC>SITHENSI=SC
690 PRINT"{HOME}"TAB(5)"{RVS}{RED}SCORE
    {OFF}{BLK}"SC:PRINTTAB(16)"{RVS}{7}HI
    GH{OFF}{BLK}"SI
700 PRINT"{HOME}{19 DOWN}"TAB(9)"AGAIN?
    {RVS}T{OFF}=TREBLE {RVS}B{OFF}=BASS":
    GOSUB770:GOTO480
710 POKE2737+I,0:SC=SC+(600-T)
720 IFJ1>2ANDJ1<16THENSOUND1,N1(J1+X1+L),
    25
730 GOTO610
740 F=15+L:G=8+L:K=-1:GOSUB760
750 F=8+L:G=15+L:K=1:GOSUB760:RETURN
760 FORP=FTOGSTEPK:SOUND1,N1(P),20:NEXTP:
    RETURN
770 POKE239,0:GETKEYA$:IFA$="T"THENL=0:Z=
    0:X1=0:GOSUB800:RETURN
780 IFA$="B"THENL=7:Z=-2:X1=5:GOSUB800:RE
    TURN
790 POKE65298,196:POKE65299,208:PRINTCHR$
    (147):END
800 FORI=3072TO3151:POKEI,32:NEXT:RETURN
```

VIC Quiz Generator

(Article on page 66.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

```
100 POKE36879,110                       :rem 143
110 READA$:IFA$<>"999"THENN=N+1:GOTO110
                                        :rem 19
120 RESTORE:DIMQ$(N),C(N)               :rem 237
130 X=RND(0):V=36878:S2=36875           :rem 116
140 S$="{WHT}WHO WROTE "                :rem 17
150 PRINT"{CLR}{8 DOWN}{RVS}{RIGHT}{PUR}
    {20 SPACES}"                        :rem 77
160 PRINT"{RIGHT}{RVS}{YEL} VIC QUIZ GENE
    RATOR "                             :rem 7
170 PRINT"{RVS}{RIGHT}{PUR}{20 SPACES}"
                                        :rem 52
180 GOSUB510                            :rem 175
190 FORI=1TON:READQ$(I):NEXT            :rem 7
200 T=0:FORI=1TON:C(I)=2:NEXT           :rem 27
210 PRINT"{CLR}{WHT}{9 DOWN}SHUFFLE QUEST
    IONS ({RVS}Y{OFF}/{RVS}N{OFF})?"
                                        :rem 27
220 GETA$:ON-(A$="")GOTO220:IFA$="N"THEN2
    50                                  :rem 164
230 FORJ=1TON:T$=Q$(J):RN=INT(RND(1)*N)+1
    :Q$(J)=Q$(RN):Q$(RN)=T$:NEXT:REMSHUFF
    LE                                  :rem 151
240 REM SPLIT QUESTION/ANSWER           :rem 125
250 FORJ=1TON:IFC(J)=0ORC(J)=1THEN400
                                        :rem 235
260 QZ$="":AN$="":FL=0:FORK=1TOLEN(Q$(J))
    :M$=MID$(Q$(J),K,1)                 :rem 103
270 ON-(M$="#")GOTO310                  :rem 150
280 IFM$="*"THENFL=1:GOTO310            :rem 123
290 IFFL=0THENQZ$=QZ$+M$                :rem 207
300 IFFL=1THENAN$=AN$+M$                :rem 144
310 NEXTK                               :rem 30
```

```
320 REM ASK QUESTION & GET ANSWER:rem 166
330 PRINT"{CLR}{4 DOWN}"+S$:PRINT"{RVS}"Q
    Z$"{OFF}"+"?":INPUTRS$          :rem 227
340 IFRS$=AN$THEN370                :rem 168
350 PRINT"{3 DOWN}{BLK}SORRY...YOU'RE WRO
    NG.":GOSUB530                   :rem 29
360 PRINT"{2 DOWN}{YEL}THE ANSWER IS:":PR
    INT"{RVS}"AN$"{OFF}"+".":GOTO390
                                    :rem 3
370 GOSUB520:PRINT"{3 DOWN}{RVS}{YEL}GREA
    T...THAT'S RIGHT!"              :rem 230
380 C(J)=1                          :rem 231
390 GOSUB510                        :rem 178
400 NEXTJ                           :rem 29
410 WA=0:FORI=1TON:IFC(I)=-1THENC(I)=0
                                    :rem 29
420 IFC(I)=2THENWA=1:C(I)=-1        :rem 88
430 NEXTI                           :rem 31
440 IFWA=1THEN250                   :rem 243
450 REM SCORE QUIZ & RESET SEQ      :rem 212
460 FORI=1TON:T=T+C(I):NEXT:SC=INT(T/N*10
    0+.5)                           :rem 44
470 PRINT"{CLR}{2 DOWN}{WHT}YOUR SCORE IS
    :"SC"%"                         :rem 198
480 PRINT"{DOWN}WANT TO TRY AGAIN (Y/N)?"
                                    :rem 32
490 GETA$:ON-(A$="")GOTO490:IFA$="N"THENE
    ND                              :rem 246
500 GOTO200                         :rem 96
510 FORI=1TO2000:NEXT:RETURN        :rem 44
520 POKEV,10:FORI=110TO241:POKES2,I:NEXT:
    POKEV,0:RETURN:REM CORRECT      :rem 93
530 POKEV,10:POKES2,135:FORI=1TO300:NEXT:
    POKEV,0:RETURN:REM INCORRECT    :rem 224
1000 DATA #MOBY DICK*HERMAN MELVILLE
                                    :rem 143
1010 DATA #RED BADGE OF COURAGE*STEPHEN C
     RANE                           :rem 114
1020 DATA #THE SCARLET LETTER*NATHANIEL H
     AWTHORNE                       :rem 45
1030 DATA #THE GREAT GATSBY*F. SCOTT FITZ
     GERALD                         :rem 54
1040 DATA #TOM SAWYER*MARK TWAIN    :rem 165
1050 DATA #FOR WHOM THE BELL TOLLS*ERNEST
      HEMINGWAY                     :rem 87
1060 DATA 999                       :rem 140
```

Line Number Cross Reference

(Article on page 118.)

Program 1: Line Number Cross Reference—VIC Version

```
100 PRINT "{CLR}{3 DOWN}{2 SPACES}XREF UT
    ILITY"                          :rem 145
105 PRINT"{DOWN}LOADING";           :rem 177
110 DEFFNL(X)=X-(INT(X/256)*256)    :rem 36
120 DEFFNH(X)=INT(X/256)            :rem 132
130 DIMOF(4)                        :rem 136
140 FORI=1TO4:READOF(I):NEXTI       :rem 81
150 HM=PEEK(55)+256*PEEK(56)        :rem 27
160 HB=FNH(HM):LB=FNL(HM):POKE55,LB:POKE5
    6,HB                            :rem 2
170 N=0:CT=0                        :rem 145
180 FORI=HM-462TOHM-1               :rem 250
190 READA:N=N+1                     :rem 102
200 IFN<=20THENCT=CT+A:GOTO230      :rem 88
205 PRINT".";                       :rem 209
210 IFCT<>ATHENGOTO320              :rem 113
220 CT=0:N=0:GOTO190                :rem 154
230 IF(A<=255)AND(A>=0)THENGOTO270
                                    :rem 220
240 IFA<0THEN260                    :rem 153
250 A=HM-OF(A-300):L=FNL(A):A=FNH(A):POKE
    I-2,L:GOTO270                   :rem 174
260 A=HM+A:POKEI,FNL(A):I=I+1:A=FNH(A)
                                    :rem 242
270 POKEI,A                         :rem 126
280 NEXTI                           :rem 34
290 P=HM-113:S=P+3:PRINT"{CLR}{2 DOWN}TYP
    E SYS "P" TO":PRINT"LIST TO PRINTER."
                                    :rem 107
300 PRINT"{DOWN}TYPE SYS "S" TO":PRINT"LI
    ST TO SCREEN."                  :rem 200
310 END                             :rem 107
320 PRINT"DATA ERROR IN"(I-HM)+462+340
                                    :rem 134
330 END                             :rem 109
340 DATA 462,431,407,387            :rem 166
350 DATA 13,76,73,78,69,32,78,85,77,66
                                    :rem 114
360 DATA 69,82,13,67,82,79,83,83,32,82,13
    19                              :rem 98
370 DATA 69,70,69,82,69,78,67,69,58,13
                                    :rem 122
380 DATA 0,13,32,32,76,73,78,69,32,32,108
    1                               :rem 20
390 DATA 82,69,70,69,82,69,78,67,69,68
                                    :rem 131
400 DATA 32,65,84,13,0,13,76,73,83,84,124
    6                               :rem 21
410 DATA 73,78,71,32,67,79,77,80,76,69
                                    :rem 112
420 DATA 84,69,46,13,0,13,32,32,32,32,105
    5                               :rem 4
430 DATA 32,32,32,32,0,32,231,255,169,0
                                    :rem 104
440 DATA 32,189,255,169,4,162,4,160,7,32,
    1829                            :rem 181
450 DATA 186,255,32,192,255,162,4,32,201,
    255                             :rem 120
460 DATA 96,169,32,32,210,255,192,40,176,
    44,2820                         :rem 70
470 DATA 192,39,208,4,224,16,176,36,32,21
    0                               :rem 21
480 DATA 255,192,4,176,29,192,3,208,4,224
    ,2424                           :rem 228
490 DATA 232,176,21,32,210,255,192,0,208,
    14                              :rem 58
500 DATA 224,100,176,10,32,210,255,224,10
    ,176,2757                       :rem 143
510 DATA 3,32,210,255,152,32,205,221,96,1
    69                              :rem 59
520 DATA 0,133,9,169,10,133,42,165,122,16
    6,2324                          :rem 0
530 DATA 123,133,2,134,3,165,43,166,44,13
    3                               :rem 7
540 DATA 40,134,41,133,122,134,123,160,0,
    177,2010                        :rem 79
550 DATA 40,208,14,200,177,40,208,9,165,2
                                    :rem 217
560 DATA 166,3,133,122,134,123,96,32,115,
    0,1987                          :rem 11
570 DATA 32,115,0,133,57,32,115,0,133,58
                                    :rem 161
```

```
580 DATA 32,115,0,201,0,240,4,201,143,208
    ,1819                              :rem 192
590 DATA 11,160,1,177,40,170,136,177,40,5
    6                                  :rem 17
600 DATA 176,193,201,137,240,8,201,141,24
    0,4,2509                           :rem 98
610 DATA 201,167,208,222,32,115,0,32,243,
    220                                :rem 92
620 DATA 32,155,220,165,101,197,59,208,60
    ,165,2802                          :rem 163
630 DATA 100,197,60,208,54,36,9,48,28,169
                                       :rem 242
640 DATA 128,133,9,169,13,32,210,255,166,
    59,2083                            :rem 71
650 DATA 164,60,32,-351,169,32,32,210,255
    ,32                                :rem 107
660 DATA 210,255,169,11,133,42,198,42,208
    ,11,1914                           :rem 111
670 DATA 169,75,160,304,32,30,203,169,10,
    133                                :rem 114
680 DATA 42,166,57,164,58,32,-351,32,121,
    0,1606                              :rem 8
690 DATA 201,44,208,143,56,176,171,32,-37
    7,169                              :rem 231
700 DATA 147,32,210,255,24,162,5,160,1,32
    ,1851                              :rem 201
710 DATA 240,255,169,0,160,301,32,30,203,
    162                                :rem 97
720 DATA 20,169,61,32,210,255,202,208,250
    ,24,2983                           :rem 105
730 DATA 162,8,160,1,32,240,255,169,31,16
    0                                  :rem 11
740 DATA 302,32,30,203,169,17,32,210,255,
    165,2633                           :rem 101
750 DATA 43,166,44,133,38,134,39,160,0,17
    7                                  :rem 26
760 DATA 38,208,5,200,177,38,240,30,160,2
    ,2032                              :rem 206
770 DATA 177,38,133,59,200,177,38,133,60,
    32                                 :rem 81
780 DATA -293,160,0,177,38,72,200,177,38,
    133,1749                           :rem 126
790 DATA 39,104,133,38,56,176,215,169,55,
    160                                :rem 139
800 DATA 303,32,30,203,32,204,255,96,2250
                                       :rem 212
```

Program 2: Line Number Cross Reference—64 Version

```
90 PRINT"{CLR}{3 DOWN}{5 RIGHT}LINE CROSS
    REFERENCE UTILITY"                 :rem 6
95 PRINT"{2 DOWN}{10 SPACES}LOADING";
                                       :rem 154
100 CT=0                               :rem 149
110 FORI=1TO476                        :rem 116
120 READA                              :rem 240
130 CT=CT+A                            :rem 107
140 IFINT(I/20)<>(I/20)THEN180         :rem 167
150 READQ:PRINT".";                    :rem 119
160 IFQ=CTTHENCT=0:GOTO180             :rem 138
170 PRINT"ERROR IN DATA - LINES"200+I"TO"
    210+I:CT=0:GOTO210                 :rem 132
180 POKE49151+I,A                      :rem 173
190 NEXT                               :rem 217
200 READQ:IFQ<>CTTHEN170               :rem 241
205 PRINT"{CLR}{3 DOWN}TYPE 'SYS 49515' T
    O LIST TO THE":PRINT"PRINTER."
                                       :rem 133
206 PRINT"{DOWN}TYPE 'SYS 49518' TO LIST
    {SPACE}TO THE":PRINT"SCREEN.":rem 112
210 END                                :rem 106
220 DATA 13,76,73,78,69,32,78,85,77,66
                                       :rem 110
230 DATA 69,82,32,67,82,79,83,83,32,82,13
    38                                 :rem 96
240 DATA 69,70,69,82,69,78,67,69,58,13
                                       :rem 118
250 DATA 0,13,32,32,76,73,78,69,32,32,108
    1                                  :rem 16
260 DATA 32,32,82,69,70,69,82,69,78,67
                                       :rem 108
270 DATA 69,68,32,65,84,13,0,13,76,73,114
    3                                  :rem 28
280 DATA 83,84,73,78,71,32,67,79,77,80
                                       :rem 112
290 DATA 76,69,84,69,46,13,0,13,32,32,115
    8                                  :rem 31
300 DATA 32,32,32,32,32,32,0,32,231,255
                                       :rem 94
310 DATA 169,0,32,189,255,169,4,162,4,160
    ,1854                              :rem 227
320 DATA 7,32,186,255,32,192,255,162,4,32
                                       :rem 225
330 DATA 201,255,96,169,32,32,210,255,192
    ,40,2639                           :rem 115
340 DATA 176,44,192,39,208,4,224,16,176,3
    6                                  :rem 31
350 DATA 32,210,255,192,4,176,29,192,3,20
    8,2416                             :rem 13
360 DATA 4,224,232,176,21,32,210,255,192,
    0                                  :rem 3
370 DATA 208,14,224,100,176,10,32,210,255
    ,224,2799                          :rem 154
380 DATA 10,176,3,32,210,255,152,32,205,1
    89                                 :rem 61
390 DATA 96,169,0,133,9,169,10,133,42,165
    ,2190                              :rem 227
400 DATA 122,166,123,133,2,134,3,165,43,1
    66                                 :rem 54
410 DATA 44,133,40,134,41,133,122,134,123
    ,160,2121                          :rem 126
420 DATA 0,177,40,208,14,200,177,40,208,9
                                       :rem 214
430 DATA 165,2,166,3,133,122,134,123,96,1
    60,2177                            :rem 56
440 DATA 2,177,40,133,57,200,177,40,133,5
    8                                  :rem 15
450 DATA 166,41,165,40,24,105,3,144,1,232
    ,1938                              :rem 210
460 DATA 133,122,134,123,32,115,0,201,0,2
    40                                 :rem 31
470 DATA 4,201,143,208,11,160,1,177,40,17
    0,2215                             :rem 245
480 DATA 136,177,40,76,191,192,201,137,24
    0,8                                :rem 127
490 DATA 201,141,240,4,201,167,208,222,32
    ,115,2929                          :rem 149
500 DATA 0,32,243,188,32,155,188,165,101,
    197                                :rem 122
510 DATA 59,208,60,165,100,197,60,208,54,
    36,2448                            :rem 72
520 DATA 9,48,28,169,128,133,9,169,13,32
                                       :rem 192
530 DATA 210,255,166,59,164,60,32,113,192
    ,169,2158                          :rem 171
540 DATA 32,32,210,255,32,210,255,169,11,
    133                                :rem 101
550 DATA 42,198,42,208,11,169,77,160,192,
    32,2470                            :rem 73
```

```
560 DATA 30,171,169,10,133,42,166,57,164,
    58                              :rem 76
570 DATA 32,113,192,32,121,0,201,44,208,1
    43,2086                         :rem 42
580 DATA 76,22,193,32,87,192,169,147,32,2
    10                              :rem 85
590 DATA 255,24,162,5,160,1,32,240,255,16
    9,2463                          :rem 14
600 DATA 0,160,192,32,30,171,162,28,169,6
    1                               :rem 10
610 DATA 32,210,255,202,208,250,24,162,7,
    160,2515                        :rem 92
620 DATA 1,32,240,255,169,31,160,192,32,3
    0                               :rem 5
630 DATA 171,169,17,32,210,255,165,43,166
    ,44,2414                        :rem 115
640 DATA 133,38,134,39,160,0,177,38,208,5
                                    :rem 230
650 DATA 200,177,38,240,30,160,2,177,38,1
    33,2127                         :rem 56
660 DATA 59,200,177,38,133,60,32,171,192,
    160                             :rem 122
670 DATA 0,177,38,72,200,177,38,133,39,10
    4,2200                          :rem 10
680 DATA 133,38,76,168,193,169,57,160,192
    ,32                             :rem 147
690 DATA 30,171,32,204,255,96,2006
                                    :rem 139
```

Baker's Dozen, Part 2

(Article on page 120.)

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Program 1: Music Patterns

```
1 FORZ=54272TO54295:POKEZ,0:NEXT:POKE5429
  6,15:POKE54277,4:AA=54272:BB=54273
                                    :rem 203
10 PRINTCHR$(147)CHR$(5):POKE53280,0:POKE
   53281,0:POKE54275,8:CC=54276     :rem 203
15 FORZ=1TO10:PRINT:NEXT:PRINTTAB(9)"PLEA
   SE TURN UP VOLUME.":PRINT        :rem 58
17 PRINTTAB(9)"PRESS RUN/STOP TO STOP."
                                    :rem 168
18 FORT=1TO2000:NEXT:PRINTCHR$(147)
                                    :rem 165
20 K=INT(1000*RND(1))+1024:B=160:C=54272
                                    :rem 119
21 P=INT(11*RND(1))+1:H(1)=INT(150*RND(1)
   )+1:L(1)=INT(150*RND(1))+1       :rem 124
22 Q=INT(11*RND(1))+1:H(2)=INT(150*RND(1)
   )+1:L(2)=INT(150*RND(1))+1       :rem 128
23 R=INT(11*RND(1))+1:H(3)=INT(150*RND(1)
   )+1:L(3)=INT(150*RND(1))+1       :rem 132
24 S=INT(11*RND(1))+1:H(4)=INT(150*RND(1)
   )+1:L(4)=INT(150*RND(1))+1       :rem 136
25 T=INT(14*RND(1))+2               :rem 134
26 U=INT(14*RND(1))+2               :rem 136
27 V=INT(14*RND(1))+2               :rem 138
28 W=INT(14*RND(1))+2               :rem 140
30 FORX=1TOP:POKEK,B:POKEK+C,T:POKEAA,H(1
   ):POKEBB,L(1):POKECC,65:K=K+41:rem 178
40 IFK>1983THEN100                  :rem 17
50 IF(K-1063)/40-INT((K-1063)/40)=0THEN30
   0                                :rem 216
60 POKECC,64:NEXT                   :rem 42
100 FORX=1TOQ:POKEK,B:POKEK+C,U:POKEAA,H(
    2):POKEBB,L(2):POKECC,65:K=K-39
                                    :rem 237
110 IFK<1064THEN30                  :rem 5
120 IF(K-1063)/40-INT((K-1063)/40)=0THEN2
    00                              :rem 5
130 POKECC,64:NEXT                  :rem 88
200 FORX=1TOR:POKEK,B:POKEK+C,V:POKEAA,H(
    3):POKEBB,L(3):POKECC,65:K=K-41
                                    :rem 235
210 IFK<1064THEN300                 :rem 54
220 IF(K-1024)/40-INT((K-1024)/40)=0THEN1
    00                              :rem 255
230 POKECC,64:NEXT                  :rem 89
300 FORX=1TOS:POKEK,B:POKEK+C,W:POKEAA,H(
    4):POKEBB,L(4):POKECC,65:K=K+39
                                    :rem 245
310 IF(K-1024)/40-INT((K-1024)/40)=0THEN3
    0                               :rem 209
320 IFK>1983THEN200                 :rem 67
330 POKECC,64:NEXT                  :rem 90
340 GOTO21                          :rem 51
```

Program 2: Bleep

```
10 PRINTCHR$(147)CHR$(5):POKE53280,0:POKE
   53281,0                          :rem 242
20 FORX=1TO9:PRINT:NEXT:PRINTTAB(12)"TURN
    UP VOLUME."                     :rem 181
30 PRINT:PRINTTAB(9)"HIT ANY KEY TO BEGIN
   ."                               :rem 72
35 PRINT:PRINTTAB(9)"HIT RUN/STOP TO STOP
   ."                               :rem 199
40 GETA$:IFA$=""THEN40              :rem 235
50 PRINTCHR$(147)                   :rem 224
60 FORR=54272TO54295:POKER,0:NEXT   :rem 28
70 POKE54296,15:FORT=1TO500:NEXT    :rem 198
80 POKE54277,4:POKE54275,8          :rem 212
90 X=1524:J=54273:K=54272:L=54276:C=54272
                                    :rem 223
100 CH=INT(17*RND(1))+1             :rem 233
110 ONCHGOTO111,112,113,114,115,116,117,1
    18,119,120,121,122,123,124,125,126,12
    7                               :rem 182
111 CH=81:GOTO200                   :rem 201
112 CH=86:GOTO200                   :rem 207
113 CH=91:GOTO200                   :rem 204
114 CH=92:GOTO200                   :rem 206
115 CH=102:GOTO200                  :rem 247
116 CH=108:GOTO200                  :rem 254
117 CH=123:GOTO200                  :rem 252
118 CH=127:GOTO200                  :rem 1
119 CH=160:GOTO200                  :rem 255
120 CH=171:GOTO200                  :rem 249
121 CH=204:GOTO200                  :rem 247
122 CH=205:GOTO200                  :rem 249
123 CH=209:GOTO200                  :rem 254
124 CH=214:GOTO200                  :rem 251
125 CH=233:GOTO200                  :rem 253
126 CH=236:GOTO200                  :rem 1
127 CH=238:GOTO200                  :rem 4
200 LO=INT(255*RND(1))+1:HI=INT(255*RND(1
    ))+1                            :rem 250
210 CO=INT(15*RND(1))+0             :rem 239
220 Y=INT(4*RND(1))+1               :rem 134
230 ONYGOTO231,232,233,234          :rem 166
```

```
231 X=X+1:GOTO300                          :rem 229
232 X=X-1:GOTO300                          :rem 232
233 X=X+40:GOTO300                         :rem 26
234 X=X-40:GOTO300                         :rem 29
300 IFX<1064THENFORT=1TO1000:NEXT:GOTO360
                                           :rem 66
310 IFX>1983THENFORT=1TO1000:NEXT:GOTO360
                                           :rem 79
320 POKEJ,HI:POKEK,LO                      :rem 70
330 POKEX,CH:POKEX+C,CO                    :rem 193
340 POKEL,65:FORT=1TO10:NEXT:POKEL,64
                                           :rem 84
350 GOTO200                                :rem 99
360 PRINTCHR$(147):X=1524:GOTO100:rem 179
```

Program 3: Chimes

```
10 PRINTCHR$(147)CHR$(5):POKE53280,0:POKE
   53281,0                                 :rem 242
20 PRINT:PRINT"HIT SPACE BAR TO HEAR ANOT
   HER CHIME."                             :rem 136
30 PRINT:PRINT"HIT ANY KEY TO END.":FORT=
   1TO1500:NEXT                            :rem 30
40 S=54272:REM START OF SOUND CHIP
                                           :rem 230
50 FORL=0TO24:POKES+L,0:NEXT:REM CLEAR
   {2 SPACES}SOUND CHIP                    :rem 72
60 POKE54296,15:FORT=1TO500:NEXT:
   {3 SPACES}REM FULL VOLUME + TIME DELAY
                                           :rem 183
70 PRINTCHR$(147):A=INT(255*RND(1))+1:
   {2 SPACES}REM GENERATES RANDOM FREQ FO
   R VOICE 1                               :rem 151
80 POKE54273,A:N=N+1:PRINT:PRINT:PRINT"VO
   ICE ONE FREQUENCY=";A                   :rem 212
90 POKE54277,09:POKE54278,00:REM ADSR
                                           :rem 125
100 B=INT(255*RND(1))+1:REM GENERATES
    {3 SPACES}RANDOM FREQUENCY FOR VOICE
    {SPACE}3                               :rem 147
110 POKE54287,B:PRINT:PRINT"VOICE TWO FRE
    QUENCY =";B                            :rem 231
120 FORN=1TO50:POKE54276,21:REM 21=17+4,
    {SPACE}TURN ON TRI WAVE + RING MOD, N
    O. HITS                                :rem 97
130 FORT=1TO300:NEXT:POKE54276,20:REM
    {4 SPACES}TIME BETWEEN CHIMES:rem 251
140 GETA$:IFA$=""THENNEXT                  :rem 247
150 IFA$=" "THEN70                         :rem 161
```

Program 4: Tuba

```
10 POKE53280,0:POKE53281,0:PRINTCHR$(147)
   CHR$(5):POKE650,128                     :rem 189
20 S=54272                                 :rem 246
30 FORL=0TO24:POKES+L,0:NEXT               :rem 20
40 POKE54277,108:POKE54278,96:REM ADSR
                                           :rem 183
50 POKE54295,1:REM RESONANT FILTER:rem 72
60 POKE54296,31:REM HIGH-PASS IS 79,
   {5 SPACES}BANDPASS IS 45, LOW-PASS IS
   {SPACE}31                               :rem 220
70 FORT=1TO9:PRINT:NEXT:PRINTTAB(12)"TURN
    UP VOLUME.                             :rem 148
75 PRINT:PRINTTAB(6):INPUT"HOW FAST (0=FA
   ST 500=SLOW)";D                         :rem 202
80 PRINT:PRINTTAB(7)"HOLD ANY KEY TO HEAR
    TUBA."                                 :rem 116
90 READX,Y:IFX=-1THENEND                   :rem 36
100 POKE54273,X:POKE54272,Y:REM FREQ
                                           :rem 135
110 GETA$:IFA$=""THEN110                   :rem 71
120 POKE54276,33:REM TURNS NOTE ON
                                           :rem 233
130 FORT=255TO1STEP-10:POKE54294,T:NEXT:F
    ORT=1TOD:NEXT:POKE54276,32             :rem 245
140 REM TRY ALSO 1 TO 255 STEP 5           :rem 136
150 GOTO90                                 :rem 56
160 DATA5,185,5,103,4,208,4,73,3,210,3,15
    5,3,54,2,220,-1,-1                     :rem 87
```

Program 5: Good Vibes

```
10 POKE53280,0:POKE53281,0:PRINTCHR$(147)
   CHR$(5)                                 :rem 242
20 FORZ=54272TO54295:POKEZ,0:NEXT:REM CLE
   AR SOUND CHIP                           :rem 90
30 POKE54296,15:POKE54277,12:POKE54278,25
   2:POKE54275,8:REM VOL, ADSR, HI PULSE
                                           :rem 230
35 PRINTCHR$(147):PRINT:PRINT"PLEASE TURN
    UP VOLUME ON TV OR MONITOR.            :rem 81
36 FORT=1TO2000:NEXT                       :rem 240
40 PRINTCHR$(147):PRINT:PRINT:PRINT"VOICE
    1, 2, 3, 4 OR 5?                       :rem 47
50 GETA$:IFA$<>"1"THENIFA$<>"2"THENIFA$<>
   "3"THENIFA$<>"4"THENIFA$<>"5"THEN50
                                           :rem 173
60 IFA$="1"THENM=17:V=1                    :rem 43
70 IFA$="2"THENM=33:V=2                    :rem 44
80 IFA$="3"THENM=65:V=3                    :rem 52
90 IFA$="4"THENM=129:V=4                   :rem 104
100 IFA$="5"THENM=21:V=5                   :rem 89
110 POKE54276,M:REM WAVEFORM               :rem 199
120 PRINTCHR$(147)                         :rem 14
130 C=INT(50*RND(1))+1:D=INT(150*RND(1))+
    1:E=INT(100*RND(1))+1                  :rem 143
140 PRINT:PRINT"VOICE = ";V                :rem 113
150 PRINT:PRINT:PRINT"HIT SPACE BAR TO PL
    AY A RANDOM VIBE{5 SPACES}OVER AND OV
    ER."                                   :rem 149
160 PRINT:PRINT"REPEAT IF DESIRED."
                                           :rem 173
170 PRINT:PRINT"HIT ANY KEY TO HEAR SAME
    {SPACE}SOUND ONCE AND LIST ITS VALUES
    "                                      :rem 122
180 PRINT:PRINT"HOLD ANY KEY DOWN TO CYCL
    E THROUGH{6 SPACES}RANDOM SOUNDS."
                                           :rem 96
190 PRINT:PRINT"HIT 'V' TO CHANGE VOICES.
    "                                      :rem 251
200 IFPEEK(203)=64THENPOKE54273,0:POKE542
    72,0:GOTO200                           :rem 96
210 IFPEEK(203)=60THEN280                  :rem 153
220 IFPEEK(203)=31THEN40                   :rem 98
230 FORA=CTODSTEPE:POKE54273,A:NEXTA:FORB
    =CTODSTEPE:POKE54272,B:NEXTB           :rem 27
240 FORA=DTOCSTEP-E:POKE54273,A:NEXTA:FOR
    B=DTOCSTEP-E:POKE54272,B:NEXTB
                                           :rem 118
250 PRINT:PRINT"LO FREQ=";C", HI FREQ=";D
    ", STEP=";E:POKE54273,0:POKE54272,0
                                           :rem 154
260 IFPEEK(203)=64THEN260                  :rem 160
270 GOTO120                                :rem 101
280 FORA=CTODSTEPE:POKE54273,A:NEXTA:FORB
    =CTODSTEPE:POKE54272,B:NEXTB           :rem 32
290 FORA=DTOCSTEP-E:POKE54273,A:NEXTA:FOR
    B=DTOCSTEP-E:POKE54272,B:NEXTB:GOTO20
    0                                      :rem 128
```

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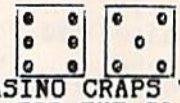

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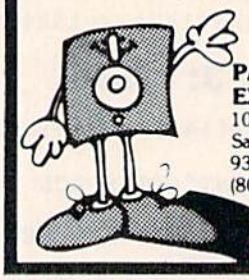

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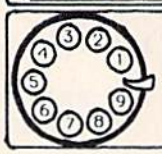

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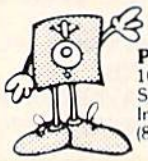

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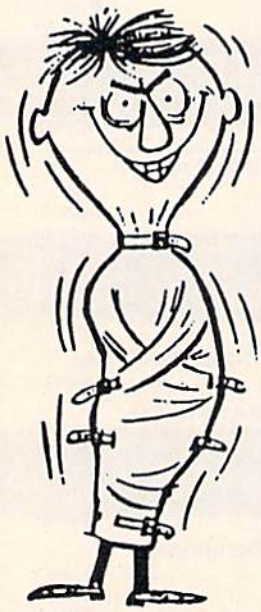

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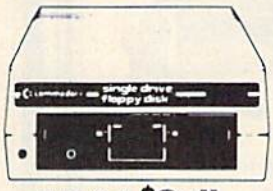

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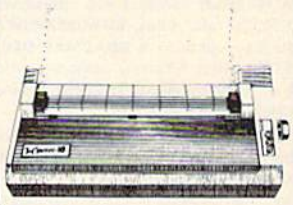

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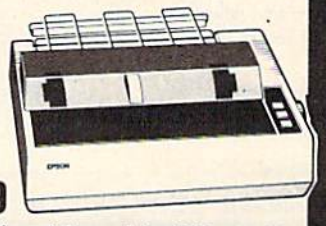

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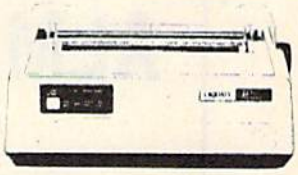

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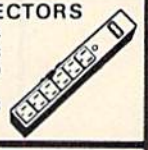

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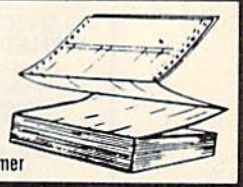

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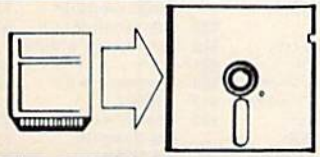

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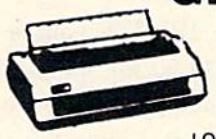

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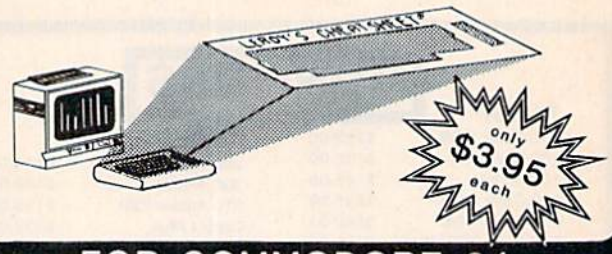

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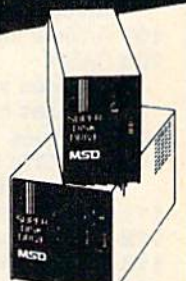

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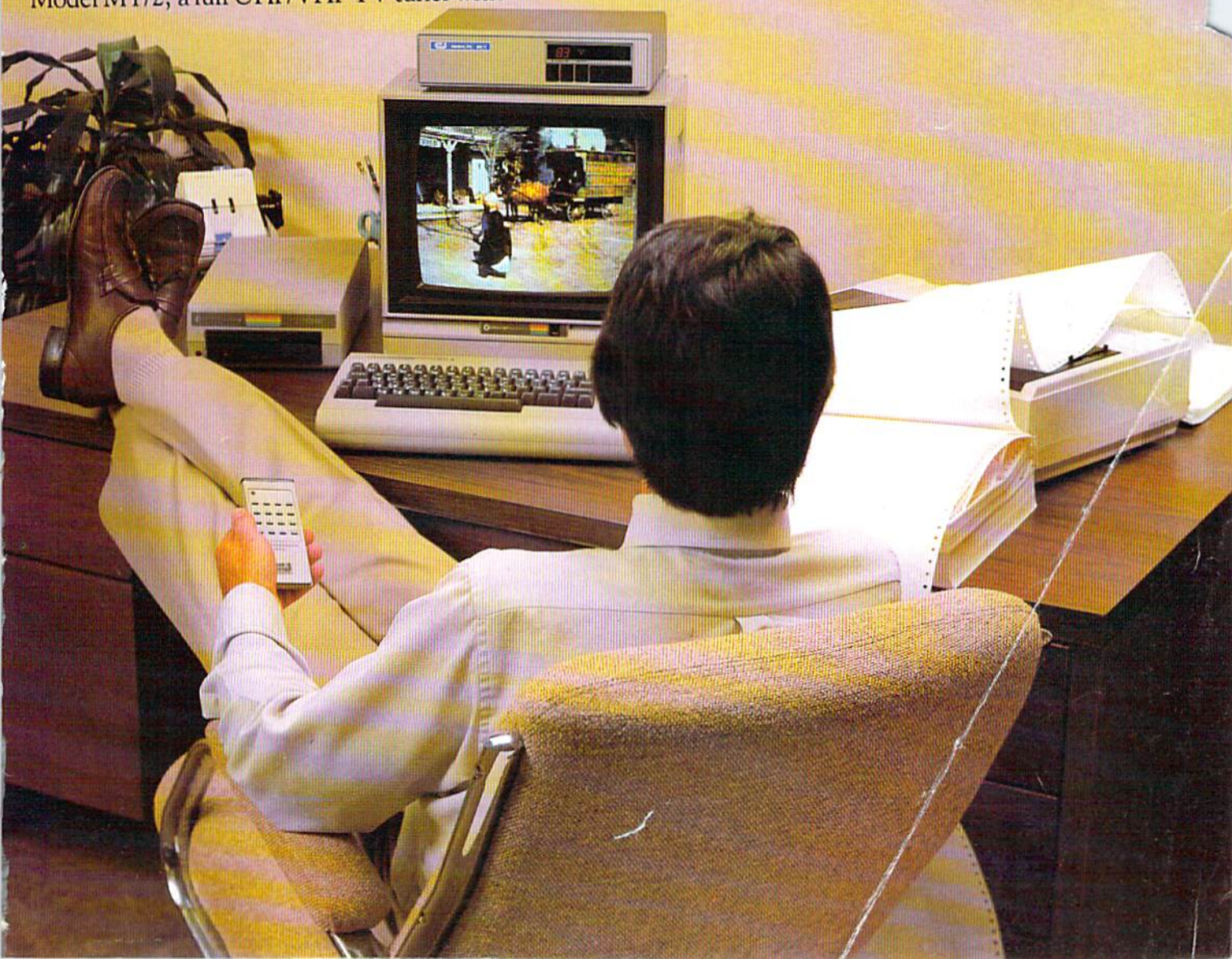

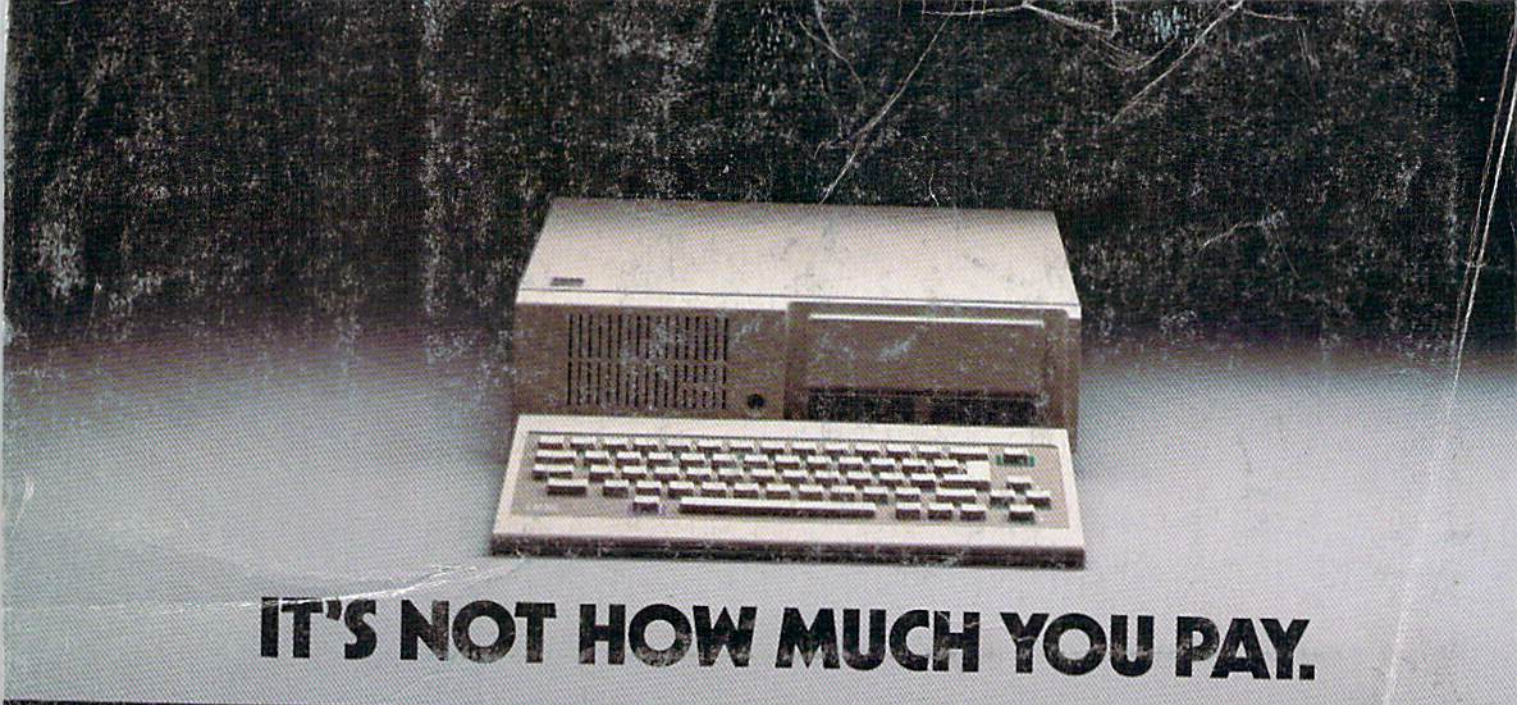

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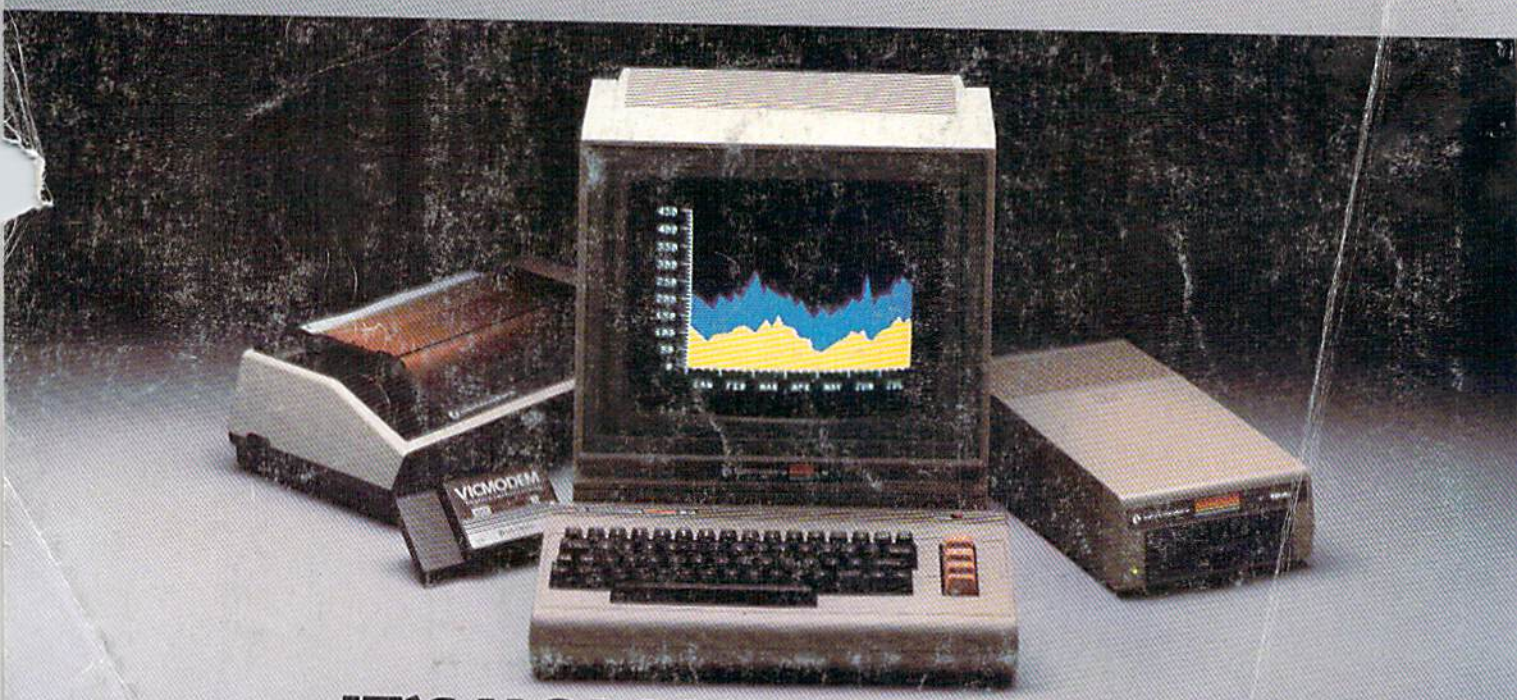

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